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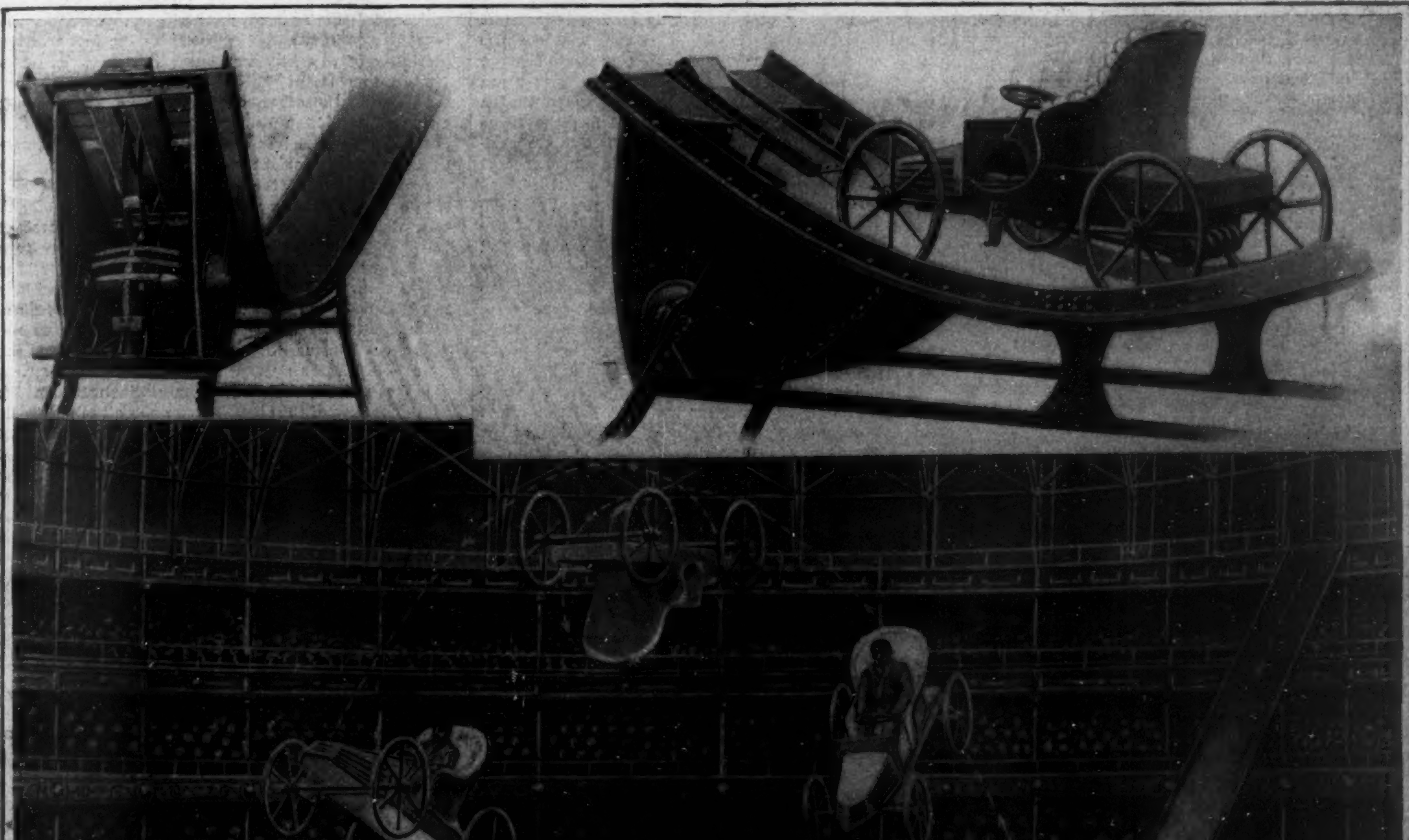

The "Whirlwind of Death," an Aptly-Named Apparatus which has Killed One Performer and in which an Automobile is Made to Turn a Somersault Before It Touches the Ground.

A HUNDRED WAYS OF BREAKING YOUR NECK.—[See page 302.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, OCTOBER 14, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

FILTRATION AND THE FUTURE WATER SUPPLY FOR NEW YORK CITY.

It is gratifying to know that the Board of Water Supply of this city have laid it down as a *sine qua non*, in any future extension of the water supply, that the plans shall include a system of filtration. One of the earlier commissions that investigated the subject proposed the establishment of pumping stations on the Hudson River, by which the water was to be raised to filtration beds located on the adjacent hills, at a sufficient elevation to insure the delivery of the water by gravity to New York. The latest scheme and that which has been adopted by the Board of Water Supply contemplates using the mountain waters of the Catskill region, which are to be impounded in a large reservoir on Esopus Creek at an elevation of 500 feet above tide level. As finally completed, the water will be delivered at the rate of 500 million gallons daily at an elevation of 300 feet above tide level at the city limits. The scheme is elastic, and provides for an early use of the water, by the delivery of the first supply that is available into the existing Croton Reservoir. This plan also contemplates the filtration of the water as thus delivered.

There is a growing conviction among sanitary engineers and the boards of water supply of our large cities that filtration is the only sure method of providing a water supply free from pollution, and particularly from the germs of typhoid fever. In cities in which filtration plants have been installed the decrease in typhoid fever has been very marked and immediate. How great is the typhoid peril may be judged from figures recently given by the State Commissioner of Health, who announced a few days ago to several hundred sanitary officers of the various counties of the State that since January 1 there has been the enormous number of 60,000 cases of typhoid fever in this State, and that in Greater New York alone there have been 500 deaths from typhoid during the nine months of the present year.

PRESENT RAILROAD TRACK INEFFICIENT.

It is not often that a form of construction which was used in the early days of an art merely because it was cheap and ready to hand shows such vitality as the present form of track, which, despite the remarkable development of the railroad, is to all intents and purposes the same to-day as it was three-quarters of a century ago. The metal rail spiked to the wood cross-tie early demonstrated that it was the best combination of cheapness and efficiency available at a time when capital was scarce and economy was a prime consideration. In the building of a new railroad, the wooden ties could be cut from the woods adjoining the right-of-way, and the rails brought up over the track already laid and quickly spiked in place. The spikes could be made by any blacksmith, and ballast was readily obtainable from the river bars, or from quarries adjacent to the railroad.

For many a decade the steel and wooden railroad track has proved that, if it be properly maintained, it is not only a simple and cheap form of construction, but one that is well adapted for its work. Of late years, however, and particularly during the last decade, the track has failed to keep pace with the remarkable improvement both in design and construction of the component parts of the railroad. Not only has the weight of locomotives and cars increased by leaps and bounds, but there has been a great acceleration in the speed, with all the increase in the dynamic or pounding effects which an increase in weight and speed must bring. It is the concentration of load on a single wheel, and not so much the total load of the whole engine or car, that batters the track out of shape; and this destructive agency has grown to a point at which the total load on a single axle will amount to between thirty and forty tons. Now, thirty to forty tons was the weight of a fair-sized passenger engine twenty-five years ago, and it is twice the weight of the engines that were built at the time when the wooden cross-tie track was first introduced.

Our engineers have ever been fully alive to the weakness of our track system, and by designing rails of heavier section, increasing the number of cross-ties to the rail, and providing a greater depth of ballast, they have endeavored to keep the track up to the severe duty which was laid upon it. To within the last ten or a dozen years they succeeded in keeping pace with the demands, but to-day with concentrated loads on a single axle as high as thirty-five tons, and speeds of from sixty to eighty miles an hour, the maintenance-of-way engineer realizes that the present system of track has been developed to the limit of its capacities.

The inefficiency of the track is rendered the more conspicuous when we take note of the great advance that has been made in all the other elements that go to make up a railroad. Wooden culverts have given place to culverts of iron, concrete, or stone; the wooden trestle has been replaced by the solid fill; the Howe truss wooden bridge has given place first to the cast-iron truss, then to the more reliable pin-connected truss, and finally to the massive riveted structure with buckle plate floor and the rock ballast carried continuously across the same. Every detail, in fact, of the railroad has kept pace with the increased weight and speed of the rolling stock except the track—for to-day we are still nailing our two strips of steel down to our frail little cross-sticks of wood, and wondering how much longer we can make them hold up to their work.

We have long believed that the solution of the track problem lay in the adoption of some form of permanent longitudinal bearing for the rails, built either of steel or concrete, or possibly of a combination of the two. Engineers have long realized that the continuous longitudinal bearing, or "sleeper," presented great advantages of strength and stability, if certain difficulties connected with its maintenance could be overcome. Those of our readers who, in years gone by, may have ridden on Brunell's broad-gage railroad, which was laid upon continuous longitudinal sleepers, will remember the smoothness with which the train ran, and the total absence of violent shocks and lurchings. Although the wooden sleepers that were used proved to be altogether too soft to hold up the rails to their work, we believe that it would well repay our roads to put in a stretch of experimental track in which the rails were carried on deep, broad, continuous steel girders of trough-section, united at intervals with suitable cross-ties. With a heavy rail bolted down upon these girders, a track of enormous vertical and lateral stiffness would be provided; and because of its great depth, ample girder strength would be provided at the rail joints—that weak point in all our present track construction. Another form of track construction that would surely repay investigation would be the building of continuous walls of concrete, one beneath each track, with cross walls thrown in at proper intervals. The problem in this case would be to provide a suitable form of track fastening, and also to find some suitable material to place between the rail and the concrete to prevent the pulverizing of the latter under the action of passing trains.

THE NEED FOR FEDERAL QUARANTINE CONTROL.

The people of the Southern States will, some time this fall, appeal to the country to support a policy of federal control of quarantine—certainly of interstate quarantine—and of federal aid and assistance in sanitary matters so far as they relate to contagious or epidemic diseases. A canvass of the Southern press shows 90 per cent in favor of such action.

An attempt was made to secure some action on this line after the last yellow fever epidemic of 1897, and quarantine conventions were held at Mobile and Memphis with only negative results. The popular demand then made—that control of quarantine be transferred from the local or State authorities to the federal government—was based on dissatisfaction with the former and recognition that they were not equal to the emergencies arising in an epidemic. Whether the federal government was equal to the occasion was as yet unknown or not sufficiently proved. A change was desired and it was felt that it could not be for the worse. In the present agitation, there is a strong feeling in favor of federal control of quarantine, of federal assistance in case of epidemic and even of federal aid in sanitary education and the extension of sanitary measures, on much the same line as was followed in Cuba during the military occupation of the island.

The United States Marine Hospital Service has been able to place only a few of its representatives in the yellow fever section—less than fifty in all—and the expenses of the campaign have been less than the State quarantine dues at a single southern port—New Orleans. There have been to date about 3,600 cases of fever throughout the Southwest, and 452 deaths from that disease—fewer deaths than occurred from yellow fever in New Orleans alone in two days of 1853, when that city had one-third the population it has to-day.

But the lives saved, and the suffering avoided, is but one feature of the improvement brought about by placing the control of affairs in the infected towns and districts in charge of a body of skilled sanitary officers, acting upon a fixed policy, unaffected by political or financial interest, and dealing equally with all, rich and the poor alike. The results of the sanitary campaign inaugurated by the United States Marine Hospital Service in the South, the interest aroused in sanitation, and the sanitary overhauling and improvement secured, have been productive of far more good than the war on the yellow fever itself.

No one who has not been in the fever section can appreciate the great sanitary advance made there in the last two months. A study of the vital statistics will shed some light on this question. The New Orleans papers have called attention to the fact that the mortality of that city was lower in August and September, in spite of the presence of the yellow fever, than during the other months of the year when the city was free of the disease. This does not mean that the yellow fever drives out other maladies, but simply that the encouragement given to sanitary work under the stimulation of the Marine Hospital Service, as shown in the draining of ponds, the cleaning of gutters, the fumigation of the houses, the removal of trash and debris of all kinds, has put the city in a much better sanitary condition than it has ever been before. Hence its general health has improved and there has been a decline in deaths from pneumonia, malarial fever, and other diseases due to bad drainage, bad water, or filth, more than sufficient to make good the twenty-odd deaths claimed weekly by yellow fever.

Perhaps this is most strikingly illustrated in the negro quarters of the city. These, as in all other Southern cities, are public scandals. The simplest laws of hygiene are openly violated through the ignorance of the negroes, and the local health authorities, finding the task of cleaning these districts greater than that facing Hercules at the Augean stables, have usually done little or nothing to improve the situation. As a consequence the mortality from disease among the negroes of the Southern cities continues from year to year at epidemic figures, reaching 46.7 per thousand a year at Charleston, S. C., and 56.6 per thousand at Shreveport, La. Taking the South as a whole, the negro mortality is nearly twice that of the whites, and more than twice what it ought to be.

Under the educational methods now being pursued, directed by the Marine Hospital Service and with the encouragement of the whites, a marked impression has been made on the negroes. The decline in the negro death rate from 42.4 per thousand (census year) to 27.2 per thousand in the midst of an epidemic is not accident, but a natural sequence of sanitary education. It means the saving of several hundred lives a year, the avoidance of several thousand cases of illness, and a great increase in the productive capacity of the negro as a worker.

In the single task of educating the people to the mosquito theory of the origin of yellow fever, and thereby inducing them to take the precautions necessary to protect themselves against the disease, the best possible results have been accomplished. Governor Blanchard, of Louisiana, and Vardaman, of Mississippi, announced themselves as disbelieving in the mosquito theory and unwilling to base their quarantines on it; but both have been converted. Probably not one per cent of the people of Mississippi accepted that scientific discovery at the beginning of the campaign. A lecture delivered on the subject at Jackson, the State capital, by a physician of the United States Marine Hospital Service was received at first with surprise, but through the teachings and practices of the federal physicians the doctrine spread over the State and has been the means of holding the fever well in check.

Perhaps no better instance of the good work accomplished in a sanitary and educational way could be shown than in the case of the Italians. These people, among whom the fever started, and who have been its worst victims, were the bane of the local health officers at the beginning of the epidemic; so much so that most of the towns prohibited the incoming of any Italians and some even ejected them. Yet the Italians, who constituted nine-tenths of the cases and deaths at the beginning of the epidemic, constitute only a small fraction to-day; the Italian quarter is nearly free from fever and is cleaner than it has ever been or any one believed it could be. Those who thought it impossible to teach the lower class of Sicilians the value of cleanliness find themselves mistaken.

The excellent results obtained in the South have been rendered possible only through a body organized and controlled by the federal government, superior to local prejudices and influence and able to act equally and justly to all. The comparatively small experience had in the matter this year has satisfied the great majority of the Southern people on this point and will bring about a practically unanimous attitude in the matter of future legislation.

EVOLUTION OF THE TOW BARGE.

BY JOHN R. SPEARS.

Although the incident received but the briefest notice in the daily papers, it is not unlikely that the sailing of the towing steamer "Col. E. L. Drake," with a 4,000-ton steel barge, loaded with petroleum, as a consort, for London recently, will, in future days, be considered one of the more important events in the history of the American merchant marine, for while tow barges and tugs as factors in the greater problems of water-borne commerce have never received any sort of consideration outside of the technical periodicals, they are now commanding the attention of the most enterprising merchants of two nations, the Americans and the Germans.

The unfortunate Fitch contemplated using steamers for towboats as early as 1786. Fulton went into freight and passenger traffic with his steamers, but it is a matter of record that many of the steamers built in the early days for freight and passengers were eventually used to tow sailing ships between the piers of New York and the open water off Sandy Hook. The first tug built as a tug was the "Rufus King," launched in 1825. The opening of the Erie Canal in the same year increased the demand for tugs because it was not possible for the canal boats to navigate the Hudson without them. In 1830 a company was formed to provide regular service for these boats, and from that day to this the long lines of canal boats astern of the slow-moving steamers have formed one of the most picturesque features of the Hudson. The long passage from Philadelphia to the Capes of the Delaware afforded another opportunity for the towboat man, and in 1836 a company was organized in Philadelphia for handling the business there.

But it was on the great lakes that the tug and the tow barge as inseparable consorts were first created. The need of tugs in the lakes trade was felt first, of course, in the passage of the Detroit and Huron rivers. Old sailors tell about spending two weeks trying to beat their way against the current from Erie to Huron, but before the civil war the towboat men had captured nearly all the up-traffic and they failed to tie in the down-bound vessels only when there was a fair wind that would drive a schooner ten knots an hour down the current.

The channel between these two lakes was narrow and crooked, and in places shoal. Such work as was found there tested the economy as well as the power of the tug to the utmost. Naturally the owners learned to build the best quality of towboats and to keep careful accounts of the actual cost of towing the various kinds of vessels used on the lakes. And after a time it was learned from these accounts that the use of a tug might be extended with profit from port to port.

In the days before and just after the civil war, Saginaw Bay was a very great lumber-producing district. Buffalo and Tonawanda, at the head of the Erie Canal, afforded the chief markets for this lumber, and it was in the trade between Saginaw and Niagara River that tow barges were first regularly used. But there is a conflict of authority as to the name of the man who first went into the tow-barge business. According to one authority Mr. John S. Noyes was the pioneer. The building of the Lake Shore Railroad having deprived a number of vessels of business, Mr. Noyes transformed two of them, the "Empire" and the "Sultana," into barges. They were put in tow of the tug "Reindeer" with such success that a third barge was added to the string. Mr. Noyes began this business in 1861. The friends of the late J. R. Van Vleck, of Tonawanda, claim for him the honor of first towing barges of lumber from Michigan ports to market, and he was certainly one of the pioneers. It is asserted that he brought his first barge loaded with lumber to Tonawanda in 1860.

From towing lumber to towing grain-laden vessels the transition was easily made, and the first grain thus brought to Buffalo was in the barge "Adams," in tow of the steamer "Graves." The "Graves" had been a schooner, but engines were put into her. It is to be observed that in the barge business before this voyage the towing had been done by tugs carrying no cargo.

From the lakes the tow-barge system eventually came to the Atlantic coast, where it was found at first to be particularly well adapted to carrying coal to ports along Long Island Sound and as far east as Providence. Schooners had had a monopoly of the coastwise coal trade, but a tug and barges could deliver the cargo much more promptly. Then they were found more economical, especially for small cargoes. Thus, where a schooner would require a crew of six or eight men a tow barge of equal capacity required but three or four. Some good-sized barges got on with two men, and they were men who received relatively small pay. The tug had a high-priced crew, but it took a dozen barges in tow and left them at the different ports alongshore, and while they were discharging cargo it came back for more, bringing along the empty barges towed out on the previous voyage.

Then the towboat men of the coast reached out for the long-distance coal trade. They built powerful tugs and bought old ships from which the masts were taken. Capacities of a thousand tons and upward were thus provided for, and with a string of from two to four of these big barges the tug was found able to take coal from Philadelphia and Newport News as far east as Boston and Portland.

So much money was made in this way that the more enterprising of the owners in the business began building barges especially for the trade, and then still greater profits were made, although the new barge cost more than the transformed sailing ship. Barges of 3,500 tons and upward were built. Necessarily tugs of the most powerful description were built to handle the barges. The "W. E. Luckenbach" is a fair sample of the high-seas tugs. She is 154 feet long, measures 454 tons gross, and has engines of 1,100 horsepower. She can tow three loaded barges from Newport News to New York in forty-eight hours. The tug "Cuba" is 165 feet long and tows three barges, each of 3,000 tons capacity, from Newport News to points east of Cape Cod.

When the tow barges had demonstrated their superiority (only the largest schooners, and those in the longest-distance traffic are now able to hold their own with the barges), oil in large quantities was discovered near the coast in Texas, and in due time barges were tried in the transportation of this oil to New York. Before this time a Dutch tug had towed an Italian vessel from Philadelphia to Genoa, crossing the ocean in seventeen days. The huge lifting dock which the Spaniards installed at Havana before Cuba was freed was towed out from England. The success of such towing ventures as these encouraged the belief that barges might enter the trade over a route as long as that from the coast of Texas to New York harbor, and when a voyage was made on a venture it proved profitable. The barge is now a regular feature of the Texas-New York trade.

After the Texas trade was established there came a sudden demand for oil, and for an oil barge and consort, on the Pacific coast. The tow steamer "Atlas" and a barge of 6,000 tons capacity, known simply as "No. 93," were sent on the trip, 13,000 miles long, and on February 26 of the present year they arrived safely in San Francisco. The log of the trip shows that the cargo was carried more cheaply than it could have been carried by a regular steamer.

The next step forward was the entrance of the barge into the transatlantic trade. Heretofore the barge had succeeded only in the coastwise trade and in such West India voyages as that to Havana, and there were reasons for supposing that an over-sea voyage would not prove profitable. For one thing, the insurance people had, for a long time, looked upon such a trip as extra hazardous. But when a barge had made the voyage through the stormy Straits of Magellan there was no longer any reason for calling any over-sea voyage of a well-built barge extra hazardous, and the only point necessary to consider was the relative cost of barge and tramp-steamer transportation. Figures made in advance had shown a profit for the barge, and on July 3 the first barge-traffic voyage across the Atlantic was begun.

Although the towing steamer carried a cargo and towed another astern of her she attained the speed of an ordinary cargo steamer and her consumption of coal was by no means equal to that of two steamers carrying as much cargo as she and her consort carried together. There was no loss of time in the passage and there was an economy of coal in thus carrying two cargoes across the ocean. At the same time the cost of the crew of the barge was far less than that of a steamer of equal capacity.

It is interesting to note that the "Drake" and her consort were fitted with wireless telegraph instruments so that in case the six-inch hawser should break communication would not be interrupted, and though they might become separated by many miles of water the steamer could easily find the barge.

While a single successful voyage does not establish a regular trade necessarily, it goes a long way toward doing so in a case like this. For it is to be noted that now and for a year past ocean traffic has been greatly depressed. Many ships have failed to make running expenses. When a system of transportation proves profitable under such conditions there is no doubt about its merits.

And to show further the confidence that towboat men have in their system, a news item from Germany may be quoted. A German company has been distributing coal around the Baltic, for some years, by means of barges. While the "E. L. Drake" and consort were crossing the Atlantic this German company took a contract to load five towing steamers and nine barges with railway material that is to be delivered in the Yenisei River, Siberia; and that is to say that these tow-barge voyages are to be made through the Arctic Ocean along the whole north coast of Europe and for twenty degrees of longitude along the north coast of Asia. If to this statement be added the further fact that Pacific coast lumbermen are preparing to tow a huge raft of timber from Seattle to Shanghai it will be seen that the tug and the tow barge are likely to become most important factors in the freight traffic of the high seas.

SCIENCE NOTES.

An interesting archæological discovery was recently made at Leagrave, near Luton (England) by the unearthing of two skeletons, estimated to be quite 2,000 years old. Beside the bones were also found a quantity of bronze ornaments. The skeletons are believed to be the remains of two females, dating back to late Celtic times, since the mode of burial was typical of that period. Both bodies were in a doubled-up position with heads to the west. Some of the bones were in a remarkably good state of preservation, especially the skull and teeth, although much discolored by contact with the earth. The bodies were found fifteen feet apart.

News has been received from Major Powell Cotton, who set out last year on an African expedition from the Nile to the Zambesi. During his travels he has gathered interesting information concerning the methods adopted by the natives of the innermost regions of the Congo Free State for the disposal of their aged members when they become a burden. The infirm and aged people are rendered unconscious by means of a narcotic, and in this comatose condition are wrapped in a fresh antelope skin. In this garb they are then hurried by the members of the family to a point remote from the village, and abandoned in the grass near a native track. The first native that passes the spot discovers what he imagines to be an antelope, and promptly dispatches it with a spear. The members of the deceased aged one's family then emerge from hiding near by, and express open horror and surprise at the unfortunate incident, though inwardly congratulating themselves upon the successful manner in which they have been relieved of their burden. When last heard of, Major Powell Cotton had left for the Stanley forest.

Dr. H. Maché, a prominent physicist of Vienna, has recently made some determinations upon the radio-active properties of mineral springs. Experimenting upon the gases, water, and solid deposits of the Gastein springs, he finds that they show the active effect which is characteristic of radium. In this case the water has a greater active power than the solid portions. It is observed that the quantity of emanation varies from one spring to another and also that there is no direct relation between the quantity and the temperature. He considers, however, that the cold springs have a tendency to be radio-active in a greater degree. To explain the differences of activity which are found in these cases, he advances the idea that the water of different springs has taken a greater or less amount of time to come from below to the surface of the ground, and this would have an effect upon the amount of emanation which they carried. He also admits the possibility that the north-and-south direction of the fissures from which the water flows would favor its richness in emanation. Dr. Maché also observed the radio-activity of the mud deposits of the Gastein springs, and found in it a mineral containing manganese which is known in Germany as Reissächerite, and is characteristic of the Gastein region. The mineral is somewhat active, being from 0.05 to 3.9 times as active as uranium nitrate, without containing any uranium salt. It is the second example of a radio-active mineral which does not contain uranium.

A new method of detecting the presence of rhodium has been brought out in a paper which P. Alvarez presented to the Academie des Sciences. He finds that the blue liquid which is obtained along with the green precipitate of ortho-rhodic hydrate, $Rh(OH)_3$, in oxidizing directly an alkaline solution of a rhodium salt by chlorine or a hypochlorite can be of considerable value in finding whether rhodium exists in a given compound. The reaction can be easily carried out as follows: An aqueous solution of a rhodium salt such as chloro-rhodate of sodium, $RhCl_3 \cdot 3ClNa = RhCl_6Na_3$, is added to an excess of soda $NaOH$ in order to obtain an alkaline solution of sesquihydrate of rhodium, $Rh(OH)_3, H_2O$. Then we act upon the liquid by a gas. The latter comes from the action of concentrated hydrochloric acid upon potassium chlorate and is brought into the test solution by a narrow tube. In this case the alkaline solution, which is very dilute and almost colorless, takes a yellowish-red color which changes at once to red. Then the red color becomes more and more intense, and the moment arrives when the gas continues to act, when the liquid begins to cloud and forms a slight green precipitate. The latter dissolves finally in the liquid to a fine blue color, which resembles that of an ammoniacal copper solution. In sulphurous liquid or gas the solution loses its blue color and becomes yellow owing to the formation of rhodic sulphate. This reaction will be of use in distinguishing rhodium from the other metals of the same group.

HOW CLINICAL THERMOMETERS ARE STANDARDIZED AND TESTED.

BY HERBERT T. WADE.

Few instruments play a more important part in illness than the clinical thermometer, and in the hands of physician and nurse it affords a most valuable indication of the condition of the patient. So useful is the observation of the bodily temperature, that changes that might seem minute and inconsequential often have a significance not to be underestimated. Consequently the accuracy of the clinical thermometer is most essential, and it is hardly an exaggeration to say that on its readings life and death may sometimes depend. For that reason physicians demand a correct instrument; and as few can test them by comparison with accurate standards, they usually are forced to depend upon the certificate accompanying the instrument. In many cases in order to have a certificate from a responsible laboratory or bureau, as that of Kew in England, or the Physikalisch-Technische Reichsanstalt in Germany, American physicians have purchased clinical thermometers of foreign make, as in the case of domestic instruments the only certificates issued in most instances were those of the maker, the correctness of whose standards there is often no means of determining.

This has been changed since the establishment of the National Bureau of Standards at Washington, now a branch of the Department of Commerce and Labor; for one of its most practical and important works is the testing of clinical thermometers. To such as meet its requirements a certificate bearing the seal of the Bureau and the signature of its director is issued, so that a purchaser or user may know what dependence to place on the accuracy of the instrument. Clinical thermometers either singly or in quantity are thus tested, and as the fees are merely nominal, the privilege is widely availed of, especially by manufacturers, who since the inauguration of this work by the bureau have seconded the efforts of its officials to raise the standard of American clinical thermometers. The Bureau of Standards has taken up this duty in a most systematic manner, and special and ingenious apparatus, the most important of which is here illustrated, has been devised to facilitate the work and is installed in a special laboratory in the recently completed building of the bureau.

Clinical thermometers are constructed in many forms, but the most usual type, designed to record the highest temperature to which they have been exposed, is self-registering, with a lens front, so that the image of the mercury thread and scale is magnified, enabling tenths of a degree to be read distinctly against the white enameled-glass background. The registration is effected by means of a contraction in the bore of the thermometer, through which the mercury when it expands in the bulb can only pass in fine globules. When the mercury has acquired the surrounding temperature and ceased to expand, it is held in the upper part of the tube by the contraction, and is not allowed to return to the bulb under ordinary conditions, until a reading has been made. However, the mercury can be forced back through this fine passage by using sufficient force, which in actual practice must be such as can be given with a quick and dexterous twist of the wrist and forearm. In this way the thread of mercury is brought below 95 deg. F. (98.4 deg. F. is the normal temperature of the body) and the instrument is in readiness to make a reading. In actual use the thermometer is placed under the tongue or elsewhere to secure the body temperature, and under ordinary conditions should assume the proper temperature in from half a minute to two minutes, the difference in time depending largely on the construction of the thermometer, such factors as the thickness of the bulb and the amount of mercury contained affecting the length of time that should elapse before a reading can be made.

Clinical thermometers, like other thermometers, should be thoroughly aged before being marked and tested, as the glass contracts and experiences other changes in the first few months. This question was one of the first to be agitated by the Bureau when the testing of thermometers was undertaken, as it was desirable to guarantee this aging. This matter has not yet been definitely determined, and consequently each certificate bears the proviso "Unless this thermometer has been suitably aged before testing, its indications are liable to change with time." In actual experiments, however, it was found that by using hard thermometer glass for the bulbs the changes in the indications after the first three or four months were practically negligible.

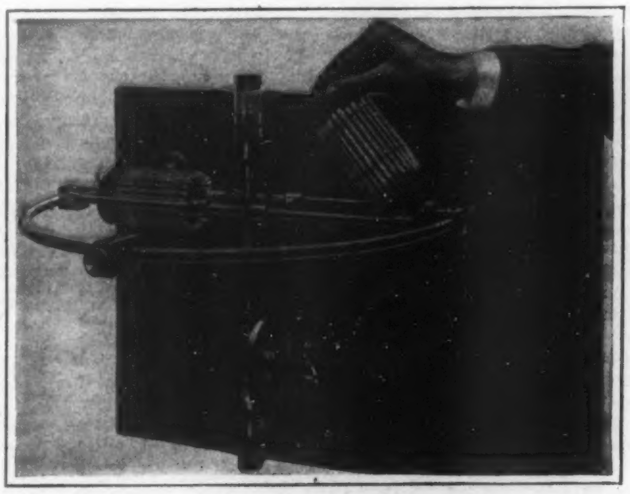


Fig. 2.—National Bureau of Standards Whirling Machine for Driving Back the Index into the Bulb.

The bureau when it began first to test thermometers found most surprising variations in the readings of different instruments under the same conditions, and as in some instruments from certain manufacturers these discrepancies were constant it was suspected immediately that the standards on which they were based were inaccurate. Accordingly the leading manufacturers of the country were invited to submit their standards for study, and in many cases their inaccuracy was soon demonstrated, while in others it was found also that an unsuitable form of standard was being used. Accordingly certain standards of the bureau were loaned to manufacturers, others constructed according to its recommendations were submitted for test, while still others were graduated or pointed at the bureau. These standards were all compared directly with the primary standards of the bureau, which are graduated according to the international hydrogen scale adopted by the International Committee of Weights and Measures in 1887. This is the Centigrade scale of the hydrogen thermometer, where the fixed points of temperature are those of melting ice and of water vapor or steam at atmospheric pressure, the hydrogen gas being taken at an initial pressure of 1 meter of mercury or 1.3158 times the standard atmospheric pressure of 760 millimeters, or 30 inches, of mercury. For comparing the standard mercurial thermometers, use is made of an improved form of comparator which forms the subject of our illustration (Fig. 1). The thermometers are immersed in a tank of water whose temperature can be controlled by means of hot and cold water supply and a system of heating coils through which current can be passed at the will of the observer, who thus is enabled to secure with accuracy any desired temperature. The thermometers are read by means of the small microscope through the glass window in the cylinder, while an electrically driven agitator keeps the water in constant circulation. Such an instrument enables a direct comparison to be made between a standard and other thermometers for all points between the boiling and freezing points of water.

Fig. 1.—National Bureau of Standards Comparator for Testing Standard Thermometers.

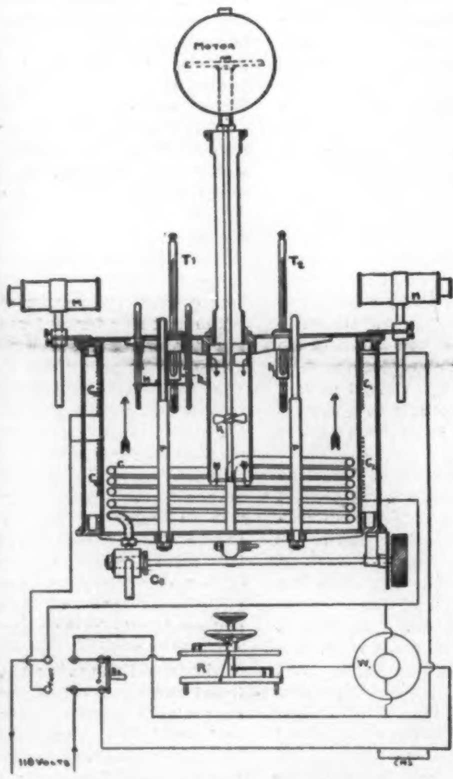


Fig. 4.—Section of Comparison Tank.

The first practical result of this activity on the part of the bureau was to bring to the same standard scale of temperature all the makers of clinical thermometers in the United States, and this was immediately shown in a highly improved grade of thermometers that were submitted when the testing work was established on a permanent and useful basis. This testing now has been reduced to a system which insures accuracy with facility of working, and a competent staff are able to pass upon all instruments submitted for test. Thermometers when first received for testing at the bureau are examined to detect any defects as regards actual construction. Thus air-bubbles in the mercury or in the capillary tube, cracks in the glass, defective graduation, and similar deficiencies eliminate the thermometers from further consideration. For the actual testing they are placed in lots of 24 in small holders in which they can be placed in the

(*Continued on page 298.*)

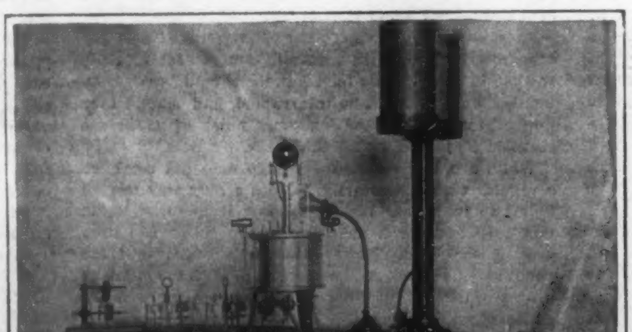


Fig. 3.—Clinical Thermometer Testing Table. National Bureau of Standards.

HOW CLINICAL THERMOMETERS ARE STANDARDIZED AND TESTED.

THE "ELBERT H. GARY"—THE GREATEST OF ORE-CARRYING STEAMERS.

BY W. FRANK M'CLURE.

Once more the size of Great Lakes vessels has been increased by the bringing out this summer of four mammoth steamers each 569 feet long, 56 feet beam, and 31 feet depth. This is 9 feet longer than the steamer "Wolvin," described in the SCIENTIFIC AMERICAN of April 30, of last year, and at that time styled by all odds the largest fresh-water vessel in the world. The four new vessels, built for the United States Steel Corporation, are known as the "Elbert H. Gary," the with sides that slope from the main deck to the tank top and ends built on the same slope. The four new vessels just launched, while they have hopper bottoms, differ from the "Wolvin" in that the cargo hold is straight about half-way up from the bottom and inclines thereafter, instead of being an incline all the way. The accompanying photograph of the hold of the steamer "Gary" nicely illustrates this point. This construction is, of course, especially designed for the accommodation of the large modern ore-handling machinery installed within the past few years at lower lake docks. On the "Gary" and her sister ships, as in foot draft it is expected that ere long they will carry 15,000 tons each at a trip. All four steamers in a season will move not less than 800,000 tons of ore, and will operate when loaded at a speed of about eleven miles an hour. At present the draft maintained at most ports on the lakes is but 20 feet. Therefore these great steamers will not load as heavily now as they will in years to come. It is said that there are not more than ten or twelve vessels in the world having a greater capacity than the "Gary," "Corey," "Perkins," or "Frick."

On the steamer "Corey" there is a new departure in

THE "ELBERT H. GARY," ONE OF THE FLEET OF FOUR MAMMOTH ORE-CARRIERS, THE LARGEST FRESH-WATER CRAFT AFLOAT. HER LENGTH IS 569 FEET.

ONE OF THE TWO CARGO COMPARTMENTS OF THE "ELBERT H. GARY." A CLAM-SHELL ORE-BUCKET MAY BE SEEN IN THE BACKGROUND.

"William E. Corey," the "George W. Perkins," and the "H. C. Frick," and were brought out in the order named, the last having been launched on August 26. These vessels, it is said, represent a total carrying capacity equal to the entire Great Lakes fleet of twenty-five years ago. Their construction indicates that the "Wolvin," launched last season, is a success and, more important still, that the day of the small carrier for ore and coal has passed beyond a doubt.

In the description of the steamer "Wolvin," heretofore referred to, it will be recalled that particular attention was given to the innovation represented in her cargo hold, which was built in the form of a hopper the case of the "Wolvin," there is an absence of stringers and stanchions below deck. Instead of the arch construction, however, the new ships have the straight girder across the deck. There are thirty-four hatches with 12-foot centers, all of which are operated from a central station. A 9-foot space between the hopper and the ship's sides and the water bottom with its depth of 5½ feet furnish a water ballast capacity of 8,500 tons, which is about 500 tons more than in the steamer "Wolvin." The engines are triple-expansion, with cylinders 24, 39, and 65 inches, with 42-inch stroke.

The four new ships cost about $1,720,000. On a 22- the way of floors. With this exception, and also the fact that the "Corey" is fitted up with elaborate passenger apartments, the four new vessels are all alike. Instead of wood, the floors of the "Corey" are all of cement. This change makes the vessel practically fireproof. A cement had to be found that would stand any amount of jar without breaking and also one that would give an adequate finish for a vessel carrying passengers. The floors with which the "Corey" is now equipped, it is claimed, are adequate in every respect. It is believed that in years to come no more wooden floors will be laid on these large ships if the cement floor proves to be all that is claimed for it.

The first of the new steamers launched, the "Elbert H. Gary," in June last, broke all previous records for Great Lakes cargoes by carrying 12,003 tons, or 13,413 net tons of iron ore from Escanaba to South Chicago. The greatest records in unloading the new ships have been made at Conneaut harbor, where a cargo of 9,945 tons was unloaded from the "Gary" in four hours and fifty minutes. The sister ship, the "George W. Perkins," was unloaded at Conneaut on July 17 of 10,514 tons in four hours and fourteen minutes. This broke all previous unloading records.

It is said that an order will be placed with the shipyards for a vessel 578 feet long in the not far distant future. This would be still 9 feet longer than the four new ships of the United States Steel Corporation. The majority of ore vessels of the future will likely be of 10,000 tons capacity or thereabout.

HOW CLINICAL THERMOMETERS ARE STANDARDIZED AND TESTED.

(*Continued from page 296.*)

whirling machine, the comparison tank, and the reading stand without undergoing further separate handling. The thermometers when received are of course all numbered, and each lot is also given a number, so that it is easy to keep the record throughout the process. First to determine the ease with which the mercury can be thrown back the whirling machine shown in Fig. 2 is employed. This mechanical device takes the place of the individual throwing back of the index by hand, a performance that often proves so discouraging to the amateur nurse. Two holders whose thermometers have been heated above the normal point are placed in a frame so that the bulbs are at the opposite extremities of a horizontal axis. This is then revolved in a horizontal plane by a vertical shaft through the agency of a crank and bevel gearing as shown in the illustration. On top of this vertical shaft is a glass tube filled with oil or glycerin, and as it is revolved the surface of the liquid takes a parabolic form, the depression of the center of course depending on the speed of rotation. This can be so gaged as to correspond with the maximum muscular effort that should be expended in throwing back the index, and all the observer has to do is simply to turn the crank until the proper speed of rotation is attained. The thermometers that do not fall below 95 deg. F. are removed and rejected, and the holder is then placed in the comparison tank where the clinical thermometers are compared directly with the testing standards of the bureau. This comparison is made at four test temperatures, 96, 100, 104, and 108 deg. F. (or 35, 37, 39, and 42 deg. in the case of Centigrade thermometers) in a water bath, where there is a constant circulation of the liquid, and two standard thermometers are employed in each series of tests. This tank, which appears in the center of the clinical testing table shown in the illustration (Fig. 3), is shown in section in Fig. 4. It is a double-walled vessel of seamless brass tubing, within which is a propeller, K, driven by an electric motor and serving to keep the water continually in agitation, the direction of the currents being shown by the arrows. The tank also contains a coil of seamless copper tubing, C, through which hot or cold water from the regular laboratory supply can flow, the temperature being susceptible of regulation by the observer through the agency of the two-way mixing cock, C_1. There are four standards, indicated by PP, on each of which one of the thermometer holders, H, is placed, thus permitting ninety-six thermometers to be immersed in the tank at once. The standard thermometers, T, T_1, pass through the cover of the tank and can be read by the small microscopes, $M\,M$. In practice, however, one microscope proves sufficient, as it can be turned readily from one standard to the other. In the annular space surrounding the inner tank there are two heating coils of cotton-covered constantan wire, C, and C_2, shellacked in place around a fine layer of mica. These coils, the resistance of each of which is 80 ohms, are connected with a 110-volt circuit, a rheostat, R, to regulate the current, and a wattmeter, W, to measure the consumption of energy in the circuit as shown in the diagram. The switch, S_1, when in the position marked "Fast," allows the entire current to flow through the heating coils, but when turned to the "Slow" position it is possible to regulate the current with considerable nicety, as well as to measure with the wattmeter the amount of electrical energy consumed in maintaining a given temperature. The illustration shows the arrangement of rheostat and switches on the side of the table, the wattmeter being inside the top of the table and read through a glass plate. The electric light illuminates the scales of the standard thermometers, while at the right end of the table are shown the hot and cold water cylinders or tanks in which it is possible by electric coils to secure at will a considerable range of temperature.

The process of testing is first to bring the temperature of the water in the comparison tank up to nearly the lowest test point, first using the hot water supply, and then by employing the heating coils and fine regulation bring the temperature to exactly 96 deg. F., when the standard thermometers are read. All of the holders are then dipped at this temperature, readings of the standard thermometer being made and noted in each case. The holder on removal is placed in a reading microscope, shown on the extreme left of the table, where the exact position of the mercury in each thermometer is observed, the holder being rotated so that each thermometer successively comes into the field of view of the microscope. These readings are all tabulated and the performance is repeated at the three other test points, after which the whirling machine is again called into requisition, and then a second and independent series of tests of the holder is made. If the thermometers pass the tests they are coated with wax and the letters "B. S." and the proper serial number are engraved on the stem, which is permanently etched by immersion in hydrofluoric acid. The bureau demands, as a condition of certification, that the difference at any point in the two series of tests shall not be more than 0.15 deg. F., and that the correction at any point shall not be more than 0.3 deg. F., while the errors in the intervals between the test points must not exceed 0.3 deg. F. Quite naturally there is a demand that thermometers be supplied without any errors—or, speaking scientifically, with a zero correction—and this requires that the manufacturers use extraordinary care in their construction. From the practical point of view it is more important that the error should be known, as if a thermometer is correct to 0.1 deg. F. it is sufficiently accurate for all ordinary work and for most purposes should prove as satisfactory as one with a zero correction, while one with a correction of 0.2 deg. F. can be used, provided the correction is considered when necessary. In the year ending July 1, 1904, of the thermometers submitted for test 88.2 per cent were certified as meeting the requirements of the board, showing that while a fair standard of construction is maintained, yet there is a need of such an official examination. Large numbers of thermometers are being constantly offered for test, and it is the general belief of those interested that the standard of manufacture is being raised. It is possible that at some future time the bureau may provide for the aging of thermometers by placing them under seal for a certain length of time, and thus be in a position to insure that they have been thoroughly seasoned. Other changes in the requirements may be made from time to time as it is found necessary, but the work so far has proved satisfactory to all parties concerned, and is representative of one side of the activity of the Bureau of Standards. The section of thermometry of the Bureau of Standards is under the capable supervision of Dr. C. W. Waidner, whose interesting papers on thermometry and pyrometry published in the Bulletin of the Bureau of Standards, and elsewhere, can be read with profit by all interested in heat measurements.

The Current Supplement.

A. Frederick Collins opens the current Supplement, No. 1554, with an article on industrial automobiles. Almost every engineer and electrician is familiar with the fact that the majority of steam-power plants are not operated under the most economical conditions. William McKay analyzes these conditions and makes some helpful suggestions. The completion of the twin tunnels under the Hudson River is described and illustrated. Sir William Crookes's paper on "Diamonds" is concluded. Dr. Alfred Gradenwitz writes on lignite producer-gas plants, describing some new installations. Although the information lately published concerning steam turbines is voluminous, it is difficult to find any unbiased general statements regarding all types of such machines. Prof. Storm Bull gives a classification of turbines and enumerates their peculiarities. Donald Murray presents a most thorough and excellent *résumé* of page-printing telegraphs. His article is of particular interest, inasmuch as he is himself one of the best known of printing telegraph inventors. Of minor articles in the Supplement we may mention those entitled "Heat," "How to Read Wild Life," and "Aluminium Alloys."

Synthetic Alcohol.

The Compagnie Urbaine has recently conducted some experiments at its factory at Puteaux concerning synthetic alcohol. A mixture of coke, lime, and various metallic oxides was subjected to the heat of an electric furnace, and a carbide obtained denominated "ethylogene," which by the action of water engendered ethylene. The latter, absorbed by sulphuric acid, furnishes sulphoninic acid, from which alcohol is extracted by distillation with water. At the same time an ether is produced, a little acetic acid, and acetone.

Production of Cocaine in Peru.

This industry has been much developed of late years. The factories producing cocaine are scattered through different localities. The production has reached 11,000 kilogrammes per year, corresponding to the treatment of about 1,500 tons of coca leaves. The leaves are exported for use in the production of wine and various medicaments. The total production of leaves is estimated to exceed 2,000 tons, not including the quantity consumed by the inhabitants. The cocaine exported from Peru is not chemically pure; it contains from one and a half to two per cent of impurities. The most important market for the product is Hamburg, where the demand is constantly increasing. At that port the crude product is purified and resold.—Revue de Chimie Industrielle.

Correspondence.

Soaring of Birds.

To the Editor of the Scientific American:

In the summer of 1872 I was visiting on the Warm Springs Reservation in eastern Oregon. The residences of the government employes, etc., were in a deep valley between table-lands through which the water-courses had cut deep cañons. I climbed up on one of these tables, the edge of which was in most places perpendicular for ten, twenty, and more feet; and as I stood there in a strong breeze blowing against the face of the slope, a small hawk came gliding along eight or ten feet above the edge, and following the course of the edge; and he kept on until he was little more than a rod away from me. He seemed to be making no effort except a little balancing and turning in order to steer himself. The explanation seemed to me very simple; just there at the edge there was a strong, sharply-ascending current which enabled him to use wind and gravity against each other.

In the autumn of that year I went to Foochow, China, and there I found the city frequented by a species of large bird which we call a kite. It seems to be half hawk, half buzzard in its build and habits. Its flight is heavy and awkward, its wings being too big for its pectoral muscles; and their tips are not pointed like a hawk's, but broad and square across. But it is a master of the art of soaring. There are in Foochow two hills which lie square across the path of the afternoon sea breeze. Here, toward the close of a breezy autumn afternoon, a dozen or a score of these kites will resort and have a genuine coasting game. The sides of the hills are quite steep, and of course there results a strong, sharp upward current at the top. The kites come to the top, and, starting from the eddy in the lee of the top, glide out into the uprushing current, wings balancing up and down and head and tail turning and twisting, till they are in the heart of the upward current; and then they turn broadside to it and are borne upward and backward seventy-five or a hundred feet. Then they descend again into the eddy, and again steer themselves out into the uprushing current. Throughout it all there is very little flapping of the wings; and if the American boy could get his sled back to the top of the hill as easily as these kites get back into the uprushing current, no Chinaman could describe his coasting as: "Whish-sh-sh-sh—walkee backee mile!"

One autumn day here in the interior I came to a stretch of waste land by the river covered with tall, dry grass and dwarf bamboos. A Chinaman had just set fire to it, and a strong column of smoke and hot air was ascending, when I saw one of these kites steer straight into that ascending column, and begin to circle round and round in it; and as he did so, he was steadily lifted upward as much as 150 or 200 feet. Then he went soaring off again. One cool, sunny day last spring, when the air was cool, but the sun very hot, I saw a kite steering for a group of buildings just in front of me, from the dark tile roofs of which currents of heated air were ascending. I supposed that the kite was coming to see if he could nab a spring chick; but when he reached the place he at once began circling round and round, sometimes from right to left, sometimes from left to right, at the same time drifting away before a nice breeze from the north; but as he did so he was gradually carried upward till he was at least 500 feet above the ground. Then he drew in his pinions somewhat, just as a hawk does in swooping, and, turning square against the breeze, glided away to the north with the speed of a race horse.

Just west of where I now am is a long, steep slope of perhaps 2,000 feet. The lower half is in the lee of another mountain; but the upper half is fully exposed to the southwest winds of the season. Recently when the wind was almost a gale, I saw a small hawk having a merry coast. The wind was gusty, and sometimes it would bear him up finely; and he would even take a shoot both upward against gravity, and outward against the wind. Again, the wind would suddenly fail him, and then he would flutter his wings much as a kingfisher does when poising over the water, till a fresh gust came to his help.

I was much interested in the feats of Lilienthal. He had evidently mastered the kite's secret of the use of upward currents—the use of the upward current and gravity against each other—but alas! he did not have the kite's body, nor the kite's matchless skill in steering.

J. E. Walker.

Shaowu, Fukien, China, August 7, 1905.

STRATIFICATION IN VACUO: ITS PRODUCTION WITH THE INFLUENCE MACHINE.

BY HOWARD B. DAILEY.

Every experimenter in electricity who has had to do with Geissler tubes has at one time or another marveled at the beauty and the mystery of the phenomena of stratification. In producing the stratified light *in vacuo* the Ruhmkorff coil has been generally regarded as the only practically available means for the illumination of the vacuum. So common has been this impression that few experimenters, nor even the makers themselves of the tubes, have seemed aware of the valuable possibilities of the influence machine for this particular form of experiment. This, of course, has not been without its reason. While no special precaution or nicety of manipulation is required in exhibiting stratified tubes with the coil, when such a tube is essayed to be used with the static machine the first experiences are usually disappointing. As the vacuous space merely lights up with the familiar unbroken glow of the ordinary Geissler tube, without any traces of striation, the experimenter naturally concludes the desired effect to be impossible of attainment with the static machine. However, with attention to a few simple details of technique, striations can be developed with the influence machine having a distinctness and beauty, uniformity, and fixity of position never realized with the coil method of excitation.

In bringing out the striæ with the static machine two vital conditions are to be observed; namely, sufficient, though not excessive current through the tube; and the careful avoidance of all sparking, even of the minutest character, at possible imperfect contacts in any part of the circuit outside the tube. The first implies a generator of sufficient size, to begin with, whose output can then be diminished or increased by regulation of its speed. In exciting stratification tubes with machines of the Holtz type it is generally only necessary to connect their terminals direct to the poles of the machine, with careful attention to perfect metallic contacts; the minutest break where disruptive sparking can occur destroys the striation and diffuses the light. This precaution attended to, the proper strength of current must next be found by experimental regulation of the speed of the generator. As the machine slowly starts, the light within the tube is first seen as a thick nebulous line along the axis of the tube between the electrodes. This, at first continuous and steady, soon shows signs of uneasiness as the machine speeds up, and presently wavers and breaks into a beautiful series of brilliant, evenly spaced, isolated bands or strata which, when the current strength attains a certain value, settle into fixed positions and remain perfectly motionless. It is significant of this feature of steadiness that it is one specially remarked by De la Rue as characteristic of the striæ developed in his vacuum tubes by direct galvanic currents, during his now historical experiments with high-potential batteries of many hundred cells; thus, again, suggestion of the probable ultimate identity of the natures of static and voltaic forms of electrical action is here vividly brought to mind. In the study of striation by the present method, the almost total absence of the violent oscillatory movements, frequent blurring and overlapping, and uneven spacing of the striæ so characteristic of coil excitation, is an obvious advantage. The remarkable constancy of the stratification renders easy the making of photographic studies, with time exposures. Fig. 1 illustrates the beautiful uniformity, even spacing and perfect segregation of the striæ produced with a Wimshurst machine in a 12-inch tube, the effect being photographed with a three-minute exposure. In exciting stratification with the Wimshurst machine (which has probably been more largely made and used by amateurs than any other type), a simple device which from its function might be termed an atmospheric rheostat is required in conjunction with the tube. This necessity arises from a well-known peculiarity of Wimshurst machines, especially those of the sectorless type. If such machines are attempted to be run on closed circuit, or on a circuit having too little resistance, such, for example, as might be offered by a single Geissler's tube, their fields suffer such a diminution of potential as to cause a serious falling off of the output of the generator; thus, a tube may not receive sufficient energy even from a large generator to establish the stratification. This is obviated by supplementing the resistance of the tube by that of two air gaps, one on each side of the tube in series with it. But as these gaps must not be *spark* gaps, the construction shown in Fig. 2 is adopted. Two smooth metallic disks three or four inches in diameter with well rounded edges are mounted in vertical positions on short insulating standards. Opposite the center of each disk and facing it is an insulated sliding rod terminating in a fine sharp point capable of longitudinal adjustment through a space of two or three inches. The tube to be exhibited is connected as shown between the two middle posts; the two outer posts are in unbroken metallic connection with the opposite poles of the generator. With this arrangement the current passes the air gaps between the points and disks as a silent, continuous, non-sparking discharge and the stratifications within the tube are beautifully developed. In using the device, proper polarity is of vital importance. The point at the left must be connected to the *negative* side of the generator—that side which shows the *brush* effect on the collecting combs; the disk at the right is wired to the positive pole. If this order be reversed, sparking occurs at the resistance gaps and the effect is destroyed.

The "stratified" tube, without which no collection of vacuum tubes is complete, is a specially prepared Geissler tube exhausted to just the proper degree, and containing some particular residual gas or vapor whose molecular movement has been found especially compliant to certain conditions of vibration, in the peculiar ordering of which the phenomena of "resonance" has had strong suggestion of probable participation.

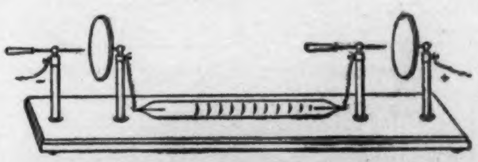


Fig. 2.—ATMOSPHERIC RHEOSTAT FOR STRATIFICATION IN VACUO WITH WIMSHURST MACHINE.

Fig. 1.—STRIATION PRODUCED WITH INFLUENCE MACHINE.

Chromatic Photography in Negative Colors.

It is a well-known fact that natural colors are reproduced by using a sensitive layer of any kind, provided it be transparent and in contact with a mercury mirror, when the colors of the object will be visible by reflection after the plate has been developed. If the sensitive layer be a bichromatic membrane, it is fixed by simply washing it with water. The colors will be visible as long as the layer is moist, but are made to disappear by drying and to reappear each time the plate is rendered moist. This phenomenon is doubtless due to the action exerted by the hydroscopic properties of the membrane, the moisture which penetrates throughout the mass producing a physical and optical heterogeneity in the plate.

In the August number of the Journal de Physique, Prof. G. Lippmann records some experiments he has performed with a view to replacing the water by solid matter. The author impregnated the plate with an aqueous solution of potassium iodide. After drying the colors were found still to exist, though quite faintly. The potassium iodide had thus remained in the plate, distributing itself unequally over the maxima and minima of interference. If, however, a solution of silver nitrate of about 20 per cent be poured out on this sensitive layer impregnated with dry potassium iodide, the colors will assume an extreme brilliancy. The plate can then be washed and dried without in any way diminishing the brilliancy of the colors. The author thinks that there has been formed silver iodide which remains unequally distributed throughout the thickness of the membrane. The latter, however, remains transparent, the iodide being contained in the state of solution in the solid matter.

An interesting feature is that the colors as seen by transparency are changed into the complementary colors, so as to produce most brilliant negatives. If the same result could be obtained by means of gelatine bromide membranes, which are much more sensitive and isochromatic, it might be possible to reproduce chromatic photographs by simple printing as in the case of ordinary photography.

A New Atlantic Cable.

The steamer "Colonia," which sailed from Canso, N. S., September 23, paying out the Commercial Company's new Atlantic cable, arrived at 6 o'clock, October 2, at a point 187 miles from the Irish coast, where she will make the final splice between the 2,000 miles of cable she has laid from the American side and the 187 miles laid from the Irish coast by the steamer "Cambria" last June.

On September 23 the weather on the Irish coast and the American coast was fine, but the "Colonia" was laying cable in a hurricane in latitude 55 minutes 55 seconds north, longitude 42 minutes 10 seconds east, blowing with the greatest force from the southeast.

This will make the fifth Atlantic cable laid by the Commercial Company.

Photographic Records of the Action of N-Rays.

The much-discussed problem of the existence of N-rays could be settled only by an objective demonstration of their effects. As these rays exert no immediate action on photographic plates, Prof. Blondlot some time ago endeavored to obtain indirect photographic records, by taking a view of the same spark first without "N" rays, and afterward with "N" rays. In the latter case a more intense impression on the photographic plate was observed. Opponents of the French scientist contended that the electric sparks were not of sufficient constancy to warrant him in drawing any definite conclusions from these experiments. Prof. Blondlot therefore continued his efforts in this direction, and in a memoir published in a recent issue of the Revue Générale des Sciences describes a few further experiments where every care has been taken to avoid any uncertainty. These experiments really demonstrate the objective existence of the radiations. The process used was practically the same as that employed previously, but for a telephone inserted in the secondary circuit of the induction coil. The assistant, by keeping the telephone receiver close to his ear, was in a position to check the regularity of the spark throughout the duration of the photographic experiments. If the spark was extinguished owing to an excessive distance of the points, the sound in the telephone was also discontinued. If, on the contrary, the points touched each other, the sound became much more intense. Any irregularities in the spark might thus be detected, and if any were observed during a photographic experiment, the photographs were rejected.

In a series of thirty-five experiments carried out with every care, twenty-three tests showed a most striking difference between the images obtained with and without N-rays, while eight tests gave a rather noticeable contrast, and four tests a contrast still visible though less marked. All the plates did show the action of N-rays, and if the difference between the two photographic impressions was not always of the same intensity, this must be ascribed to the impossibility of obtaining an absolutely exact regulation of the small spark.

It is of great importance that exceedingly feeble sparks should be employed, the brilliancy of which is little more than the minimum luminous intensity capable of producing some impression on the plate. Under these conditions a small variation in luminous intensity will result in a great variation in the intensity of the photographic image, while in the case of a stronger illumination only a very small variation is obtained.

In the experiments referred to, the N-rays were produced by a Nernst lamp inclosed in a sheet-metal lantern. The N-rays traversed successively an aluminium foil constituting the front wall of the latter, a pinewood plank two centimeters in thickness, another aluminium foil, an aluminium lens, a zinc foil, a board of whitewood two centimeters in thickness, an aluminium foil, constituting an electric screen to protect the spark, and finally the wall of the pasteboard box inclosing the spark.

With all these experiments one second more has been allowed for the total duration of the exposure made without N-rays so as to make sure that this exposure was somewhat longer than the other. Instead of simply taking two successive exposures with and without N-rays, another method, consisting in cross-wise fractional photography, has been chosen in some instances. The exposure with N-rays was made either before or after the other, either on one side of the plate or on the other, and the experiments were varied in many other ways. Metal screens were used so as to eliminate any disturbances likely to be produced by electrical influence. Checking experiments were made from time to time either by withdrawing the moist paper or by moistening it with salt water, when equivalent images were obtained in each case.

These experiments seem to be free from any objection. While the results practically agree with those obtained in connection with former researches, the following interesting fact was discovered incidentally:

If N-rays be made to strike the primary spark of a Hertz oscillator, the secondary spark will decrease in brilliancy. This shows that N-rays modify the electric phenomenon itself, and the intimate alteration of the spark is doubtless the cause for which the photographic experiments on the action of N-rays can give no decisive results in case a spark is used as illuminant, whereas no result is obtained with other sources of light.

In order to demonstrate that, if necessary, agricultural operations can be carried out day and night continuously with a gasoline motor, an interesting trial was recently carried out in England on a farm near Biggleswade. A field was illuminated by acetylene gas, and two 6-foot mowers were attached to an Ivel gasoline tractor. Under these conditions fifteen acres were cut in the short time of 3 hours, 35 minutes.

AFTERMATH OF PORT ARTHUR.

When Nogi's 11-inch mortars were dropping their high-explosive shells upon the Russian battleships and cruisers in the inner harbor of Port Arthur and sinking them, one by one, with that scientific precision with which all the Japanese operations of the war have been carried on, one could not help experiencing a feeling of pity that so many splendid vessels should be thus ruthlessly destroyed. For nobody at that time imagined for a moment that any of these ships would be again set afloat, or if floated, be capable of being put into a thoroughly serviceable condition. Not only was it supposed that the shells which sank the vessels must have damaged them beyond successful repair, but it was taken for granted that before the Russians surrendered the city of Port Arthur they would be careful to complete the work of destruction by blowing up the sunken ships with heavy charges of high explosives.

Great was the astonishment with which it was learned, upon the occupation of the fortress by the Japanese, that the latter, after making a thorough survey of the sunken ships, were confident that at least two or three of them could be raised and repaired. The statement was received with widespread incredulity both here and in Europe. But when cable dispatches from Tokio began to announce the successful flotation of now a battleship, and now a cruiser, the world perceived that, as usual, the Japanese were going to "make good," and not only raise the vessels, but place them in such thorough repair as to be able to enroll them on the list of Japanese ships in commission. The story of the sinking of the Russian Port Arthur fleet belongs to the closing days of the ever-memorable siege of the fortress and city. After the return of the roughly handled remnants of the Port Arthur fleet on the day following its defeat by Admiral Togo in the great sortie in August, the ships were moored on the northerly side of the harbor, and in the lee of a lofty hill that served to screen them from direct observation from the positions occupied by the besieging army. The location of this sheltered anchorage ground is shown very clearly by the accompanying map of Port Arthur. As long as 203-Meter Hill remained in the possession of the Russians, the ships were practically safe against bombardment, the only shots that did any damage being those which, thrown blindly into the harbor, happened to fall upon a ship at her moorings. Comparatively little damage was done to the fleet by this blind bombardment, and it was only when 203-Meter Hill was captured that the Japanese observers stationed thereon were able to render the fire of the 11-inch mortars accurate. For the sinking of the ships, eighteen of these 11-inch pieces were available, and once the Japanese were in possession of the hill they set about the sinking of the fleet with characteristic deliberation. The shots from any given battery were noted as they fell in the water and the distance that they were long, short, to the right or to the left, was duly telephoned in from the signal station. Proper corrections in the elevation of the mortars were made, and it was only a question of a few rounds before the exact range was secured. One by one the vessels were sunk at their moorings.

Perhaps the most interesting of the remarkable photographs that accompany this article, some of which were taken in Port Arthur while the bombardment of the ships was actually under way, is one giving a view of the drydock and inner basin, with the "Sevastopol" lying on the nearer side of the dock beneath the shear legs, and the armored cruiser "Bayan" lying on the farther side of the basin. The lofty column of water is not, as one might suppose, due to the explosion of a submarine mine, but to the explosion of one of the 11-inch shells from the Japanese batteries. At the time the photograph was taken, the Japanese were concentrating their attention on the armored cruiser "Bayan," and this was one of the early trial shots. The next shot fell beyond the vessel, among some coal sheds on the dock, and the third struck the ship. Shortly after this photograph was taken, the "Sevastopol" steamed out of the harbor and took position in the lee of some lofty hills that screened her from the Japanese flotilla, she was torpedoed and finally was taken out and sunk in deep water by her own captain. It will be noted that the drydock in the foreground of the picture is empty. A few hours later the mining transport "Amur" was brought into the drydock by the Russians and there blown up with mines.

Referring to our map of the sunken vessels, which was drawn from a sketch made from observations by a correspondent at Port Arthur, we draw attention to the evidence which it affords of the extraordinary activity of the Japanese in attempting to blockade the harbor. The wrecks of no less than twenty-four vessels are lying in the vicinity of the entrance, some of them sunk entirely out of sight, and others with their upper works more or less exposed. One of our photographs is taken looking out to sea through the harbor entrance; to the left is seen the rocky base of Golden Hill, the chief observation station for the fortress. In the center of the picture is seen the bow and forecastle of the large Russian ship the "Rasvornik," astern of which will be noticed the long line of davits. Between the "Rasvornik" and the shore is the wreck of the "Yinkao Maru," one of the Japanese steamers with which it was attempted, unsuccessfully, to block the entrance channel. The sunken vessels vary in size from ships of about 3,000 tons down to small wooden junks, and several of them were vessels that were laden with stone and intended to be sunk exactly in the channel. The presence of Russian ships is due to the plan of Admiral Makaroff of sinking vessels in such a way as to hinder the operations of the enemy and afford protection to the Port Arthur fleet, while still leaving open a channel for sorties.

Warships are shown in black; merchant vessels, sunk to block entrance, shown in white.

MAP SHOWING POSITIONS OF SUNKEN SHIPS AT PORT ARTHUR.

The work of the Japanese in salving the Russian battleships and cruisers is certainly one of the most astonishing feats of the many astonishing things that they have done during the late war. The vessels lay in from 45 to 50 feet of water with their main decks awash and in some cases entirely submerged. Their injuries consisted of holes that had been made chiefly by 11-inch shells, some by the bursting of the shells on the outside below the water, and others by shells which, falling almost vertically, entered the ships through the decks and passed out below the water line. The most serious injuries, of course, were those which were wrought by the Russians themselves on the night preceding the surrender, when submarine mines and large charges of high explosive were detonated both against the outside and in the interior of the hulls. It is probable that the Russians imagined they had blown up the sunken vessels beyond any chance of recovery by the Japanese; although it has been stated that the reason why the ships were not more completely wrecked by the Russians is that they were so confident of the success of Admiral Rojestvensky's fleet and of the ultimate recapture of Port Arthur, that they merely injured the ships sufficiently to insure that the Japanese could not make any use of them during the war, but that they purposely refrained from wrecking them to complete destruction, in the expectation that they themselves would be able eventually to raise the ships and put them in serviceable condition. The story finds favor among the Japanese themselves, but we must confess that to us it looks a little far-fetched, and would indicate a forethought on the part of the Russians that seems to have been sadly wanting in the other operations of the war. The Russians state that the reason the ships were not more completely wrecked was that General Stoessel failed to give the navy sufficient time to do the work. It was not until after sundown on the night before the surrender that the navy was ordered to blow up its vessels. The Russian officers claim that in the prevailing confusion, and in the limited time available, it was impossible to carry out the necessary diving operations and place the charges of explosive with the care and completeness which were necessary.

RUSSIAN SHIPS ADDED TO JAPANESE NAVY.

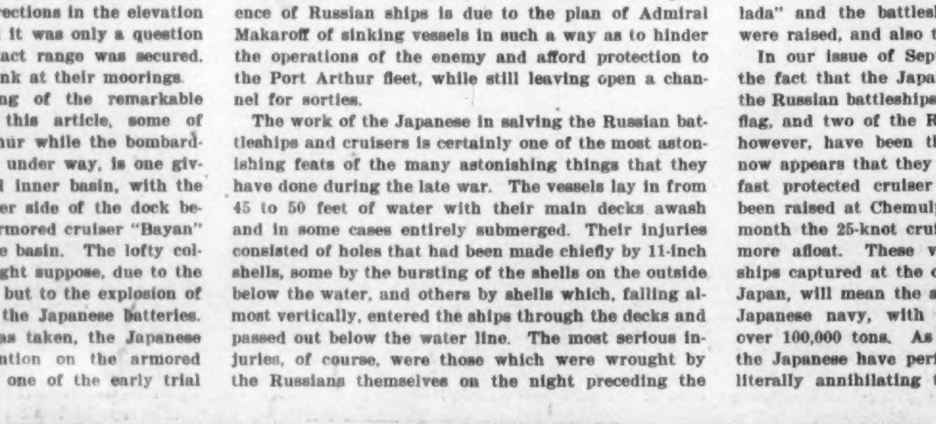
Name.	Type.	Date.	Displacement.	Speed.
Orel	Battleship.	1904	13,566	18
Nikolai I	"	1892	9,700	15.5
Retvizan	"	1900	12,700	18.8
Pobieda	"	1901	12,670	18
Peresviet	"	1901	14,674	18.3
Poltava	"	1898	11,000	16.5
Apraxin	Coast Defense.	1895	4,126	16
Semavin	"	1895	4,126	16
Bayan	Armored Cruiser.	1902	7,800	21
Pallada	Protected Cruiser	1902	6,630	20
Varlag	"	1901	6,500	24
Novik	Cruiser Scout.	1902	3,000	25

Total displacement, 100,[illegible]92 tons.

After the surrender the Japanese wrecking companies bent every energy to the saving of these valuable ships. The smaller holes were plugged up, and the larger openings were inclosed with cofferdams or rendered water-tight by the free use of canvas, planking, and cement. All through the spring and summer the salvage operations were steadily prosecuted, and on July 22 it was officially announced from Tokio that the Russian battleship "Poltava" had been refloated. Soon after came another official announcement that the "Peresviet" was afloat. Then in quick succession the cruiser "Pallada" and the battleships "Retvizan" and "Pobieda" were raised, and also the armored cruiser "Bayan."

In our issue of September 9 we drew attention to the fact that the Japanese were likely to put four of the Russian battleships in commission under their own flag, and two of the Russian cruisers. So successful, however, have been their salvage operations that it now appears that they will also add to their navy the fast protected cruiser "Varlag," which has recently been raised at Chemulpo, and that during the present month the 25-knot cruiser scout "Novik" will be once more afloat. These vessels, together with the four ships captured at the close of the battle of the Sea of Japan, will mean the addition of a dozen ships to the Japanese navy, with an aggregate displacement of over 100,000 tons. As a result, it will be found that the Japanese have performed the unparalleled feat of literally annihilating the whole navy of the enemy, not only without aggregate loss to themselves, but with a positive and very large increase in strength.

The true test of the fighting strength of two navies is the number of fast armored ships that they can place in the first line of battle. At the commencement of the war Japan possessed six battleships and eight armored cruisers. At the close of the war, after performing feats of arms which in the practical results achieved are without parallel, Japan emerges with ten battleships and


This battleship is a sister to the "Pobieda," sunk and raised at Port Arthur, and to the "Osliabia," sunk in the battle of the Sea of Japan.

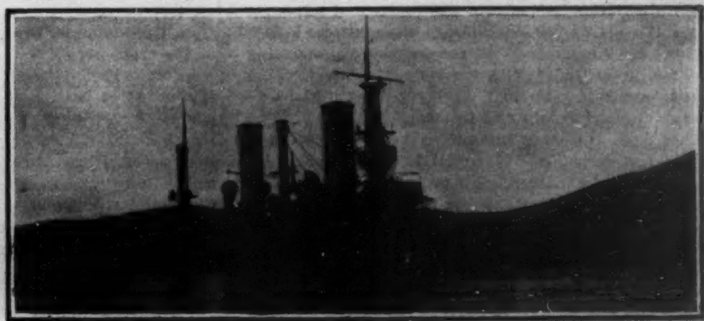
Battleship "Peresviet."

RUSSIAN WARSHIPS THAT HAVE BEEN REFLOATED AND ADDED TO THE JAPANESE NAVY.

nine armored cruisers, four of the battleships and the armored cruiser having been raised at Port Arthur and two of the battleships being captured in the Sea of Japan. In addition to these she has captured two coast-defense vessels, the "Apraxin" and "Seniavin," and has raised the protected cruisers "Pallada," "Variag," and "Novik." Of these vessels, the battleships "Orel" and "Retvizan" are the most valuable, carrying the most modern armor and guns. The "Pobieda" and "Pallada" are armed with the 10-inch gun as their principal weapon, and the guns of the "Poltava" are of an old pattern. The "Nokolai" is an old ship and will be relegated by the Japanese to the inner line of defense. She should never have been sent to the Far East. The cruisers are all fine vessels, and the "Bayan" in particular will be a valuable addition to the already large fleet of ships of the armored class possessed by the Japanese.

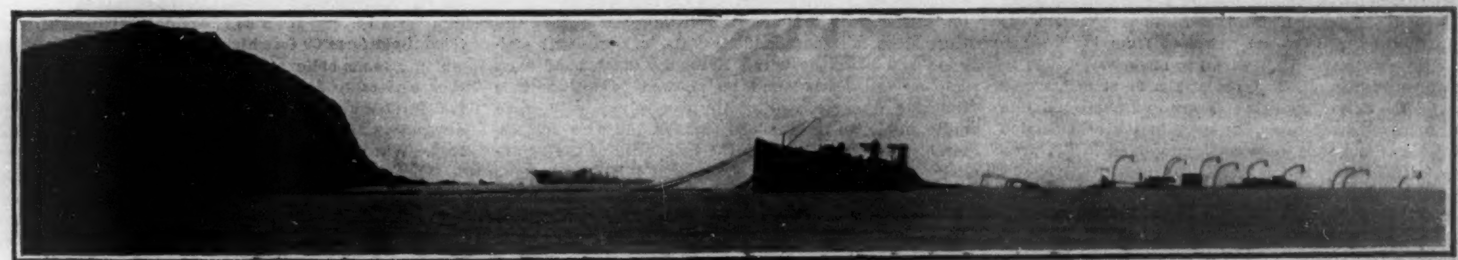
This fine battleship, built in 1902 by the Cramps of Philadelphia, was sunk in the first torpedo attack, was raised, and took a prominent part in the sortie of August 10.

Battleship "Retvizan."



The "Poltava" is a sister to the "Petropavlosk," blown up early in the war with Makaroff on board, and to the "Sevastopol," which was sunk by her captain in deep water.

Battleship "Poltava."



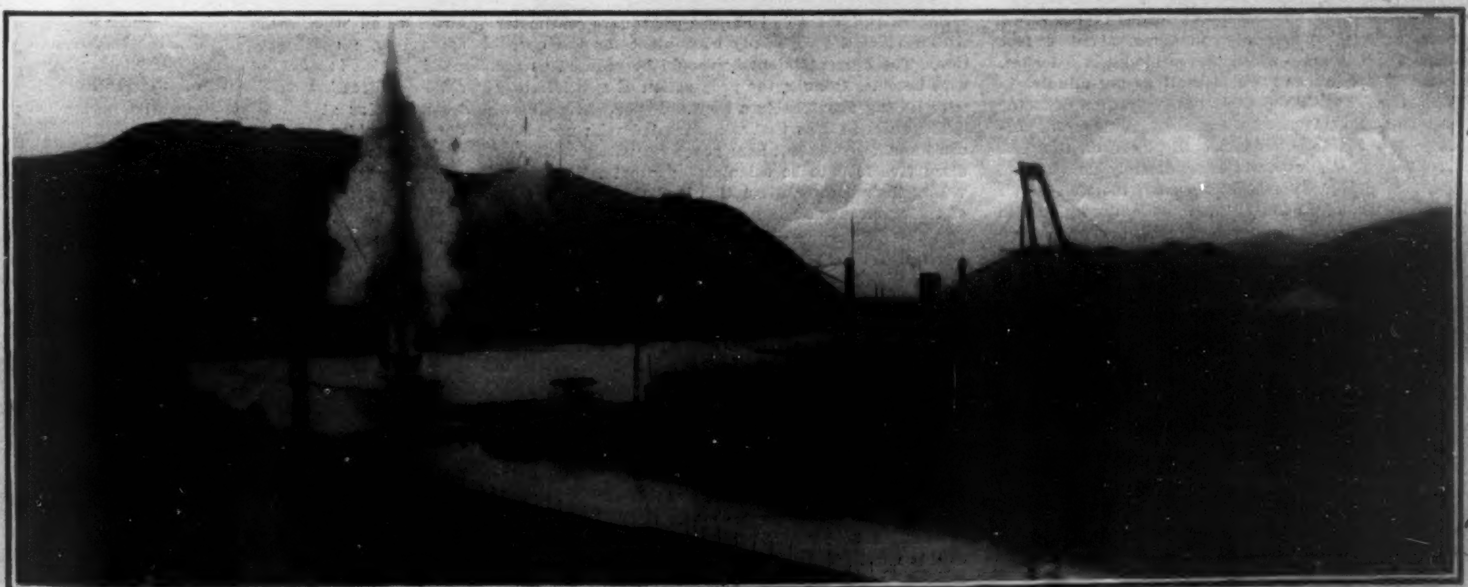
Altogether nearly two dozen vessels, big and little, were sunk by the Japanese in the endeavor to block the entrance to Port Arthur.

Entrance to Port Arthur, Looking Seaward, Showing the Sunken Merchant Vessels.

Protected cruiser "Pallada." Battleship "Pobieda." Battleship "Peresviet." Battleship "Poltava." Battleship "Retvizan."

All of these ships, and the "Bayan," sunk in the inner basin, have been raised and added to the Japanese navy.

General View of Port Arthur Harbor, Showing Positions of Sunken Ships.



On the far side of the basin is the armored cruiser "Bayan." The column of water is due to the explosion of an 11-inch shell, aimed at the "Bayan," which fell short and burst below the water. Under the direction of a Japanese observer on 203-meter hill, the successive shells fell closer until they found and sunk the ship.

View of Drydock and Inner Basin at Port Arthur During the Bombardment.

RUSSIAN WARSHIPS THAT HAVE BEEN REFLOATED AND ADDED TO THE JAPANESE NAVY.

THE SANTOS-DUMONT "NO. 14."

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Santos-Dumont has been making the first trials of his new airship, the "No. 14," on the beach at Trouville. The balloon is housed in a shed which he had built here, and he intends to carry out a number of experiments. Starting in the latter part of August, he made a series of flights over the beach and advanced above the sea. The experiments were watched with interest by large crowds of people who are spending the season at this well-known resort. During the maneuvers, Santos-Dumont was very successful in piloting the new airship and in steering it about as he wished. He expresses himself as very well satisfied with its performance. When all is in good shape he expects to make a long flight, probably above the sea, continuing the experiments he began some time ago at Monaco.

The body of the balloon is of a rather long cigar-shaped form, and it will be noticed that the position of the largest diameter is placed somewhat near the front. This shape was adopted in some of the preceding types and was found very satisfactory. The front end is considerably pointed, however. Originally it was intended to use a very long balloon body for the "No. 14," but afterward the present form was adopted, as it seemed preferable. Some new points are to be noted both in the car and in the motor and screw. The car which is suspended some ten feet from the balloon body by fine steel piano wires, is made very short in the present case. It is large at the front end, which carries the basket, and then tapers to a sharp point in the rear. Bamboo poles are used in the construction of the car, and it is very much simplified in the present case, being reduced to four long bars, braced across in the middle by a light bamboo frame. The basket is very small and light, and is just sufficient to hold the aeronaut. It is somewhat widened out in the lower part. What is especially to be noticed in the present case is the new arrangement which Santos-Dumont has adopted for placing the motor and screw. Contrary to the method which he used in the other types, he places the screw in the front of the car. Thus it moves the airship by pulling and not by pushing it, as before. Aluminium vanes are adopted for the screw, instead of the usual covered bamboo frames. The vanes are held to the motor shaft by a light bar which is riveted to them. At right angles is placed a short steel bar, and from here three steel wires run to the blades of the screw on either side. The screw measures about 6 feet across, and the outer width of the blades is 8 inches. It runs at a speed of 2,000 revolutions per minute.

The second engraving shows the disposition of motor and screw at the front of the basket. A motor of considerable size and power has been placed on the "No. 14." The present motor is of an entirely new design, and is built by the Peugeot Company, the well-known Paris automobile builders. The cylinders are placed in V shape on a circular aluminium crank box. A smooth surface is given to the cylinders, except at the upper ends, which have the usual form of radiating wings. At the ends of the cylinders is a spherical inlet head to which comes the pipe from the carbureter. The gasoline tank and induction coil are placed on the top of the car behind the basket. Back of the motor is a bamboo cross-pole for attaching the front wires of the balloon. The steering apparatus has also been reduced to a very simple form. The rudder, a hexagonal frame stretched with silk, is jointed to the balloon body at the top, and at the bottom a single pole serves to hold it. Through the middle of the rudder runs a cross-pole whose ends are connected by wires to the steering wheel in front of the aeronaut.

The Latest Creation of the Brazilian Aeronaut, in Flight.

The Airship in the Shed, Showing the Arrangement of the Motor and Propeller.

THE SANTOS-DUMONT "NO. 14."

To copper the surface of brass articles, all that is required is to wind a piece of wire round them, and dip them in dilute sulphuric acid. The zinc is dissolved from the surface of the brass, but the copper remains undissolved, and the article will appear as if coated on the surface with a layer of pure copper.

Obtaining Thin Metal Wires by Electrolytic Means.

In a recent paper before the French Academy of Sciences, Mr. Henri Abraham suggests a method for obtaining very thin mètal wires which is somewhat similar to the well-known Wollaston process of making platinum wires. The wire which is to be reduced in cross-section is taken as positive electrode in an electrolytic bath; its electrical resistance is measured from time to time, the current being stopped as soon as the cross-section of the wire has attained the figure required. The electrolytic bath should be rather dilute so as to have a very great resistance, when the current will be uniformly distributed throughout the length of the wire without its being necessary to give the two electrodes a strictly determined relative position. In fact, nearly the whole of the resistance of the liquid will be in the immediate neighborhood of the thin wire.

Distilled water containing some thousandths of its weight of copper sulphate can be used as a bath when dealing with copper wire, or else a similar amount of silver nitrate if silver wires are to be treated.

The operation should be controlled so as to be rather slow in order to allow the metallic salt forming around the wire to diffuse into the bath. Unless this precaution be taken, electrolysis will show a rather unstable behavior. Wherever the current happens to be too strong, an excess of salt will be formed, when the bath becoming too conductive, the current will augment and burn the wire. If on the other hand such salt as has been found be allowed to diffuse into the bath, the behavior of the electrolysis will prove quite stable, as the thickest parts of the wire are preferably attacked, owing to the resistance of the neighboring liquids being smallest in the neighborhood of these points.

Currents of about 0.01 ampere per square centimeter wire surface are especially convenient for the operation. The current intensity should be reduced as the wire becomes thinner, the preparation of a satisfactory wire lasting about half an hour.

The author states that wires treated with necessary caution show sufficient homogeneity to allow their new disruptive load to be calculated approximately by dividing their former disruptive load through the ratio of their present and their initial electrical resistances.

Official Meteorological Summary, New York, N. Y., September, 1905.

Atmospheric pressure: Highest, 30.36; lowest, 29.85; mean, 30.06. Temperature: Highest, 84; date, 30th; lowest, 46; date, 26th; mean of warmest day, 74; date, 30th; coldest day, 54; date, 26th; mean of maximum for the month, 72.9; mean of minimum, 60.7; absolute mean, 66.8; normal, 66.3; average daily excess compared with mean of 35 years, + 0.5. Warmest mean temperature for September, 72, in 1881. Coldest mean, 61, in 1871. Absolute maximum and minimum for this month for 35 years, 100, and 40. Average daily deficiency since January 1, — 0.3. Precipitation: 7.11; greatest in 24 hours, 3.58; date, 2d and 3d; average of this month for 35 years, 3.60; excess, + 3.51; excess since January 1, + 2.42. Greatest precipitation, 14.51, in 1882; least, 0.15, in 1884. Wind: Prevailing direction, northwest; total movement, 7,561 miles; average hourly velocity, 10.5; maximum velocity, 38 miles per hour. Thunderstorms, 3d, 20th. Clear days, 12; partly cloudy, 7; cloudy, 11.

A HUNDRED WAYS OF BREAKING YOUR NECK.

When we witness the sensational performances of acrobats, are we attracted solely by the skill exhibited in accomplishing difficult feats? There is still another element of interest, which inspires a feeling curiously compounded of admiration and a painful presentiment of danger. The guiding principle of the inventors of these acts is to give our nerves a shock more intense than any hitherto experienced, and so we are encouraging a competition in rashness in which the contestants sometimes attempt the impossible. The familiar trapeze performances, aerial ballets in which the dancers are suspended by invisible wires, balloon ascensions, and parachute drops, even the "human cannon ball" hurled by powerful springs from the mouth of a simulated cannon, though dangerous enough and often fatal, cannot compare in hair-raising power with the astounding performances of the last few years.

"Looping the loop" and its progeny are the most effective devices yet invented for producing apparent as well as real danger. Does any one still remember the American bicyclist who used to ride at terrifying speed down a steeply-inclined sixty-foot ladder? One night an attack of vertigo caused his death, but his act was less dangerous than the performances on inverted and aerial paths to which we have since become accustomed. In "looping the loop," first performed by James Smithson, better known as "Diavolo," a bicyclist starts from a platform 60 feet high and plunges down a track which extends obliquely for 100 feet to the ground, and thence rises to form a complete spiral loop 20 or 25 feet in diameter. The speed acquired by the cyclist in descending the inclined plane carries him around the loop. When "Diavolo," preceded by a great reputation, came to Paris, he found one Noiset, known professionally as "Mephisto," preparing to loop the loop at a rival music hall. In spectators supposed to be civilized these performances and their successors produced the same savage delight that was evoked by the bloody sports of the Roman circus. While several cyclists were preparing to loop the loop honestly, one man, unwilling to risk his life for the amusement of spectators, devised a loop with a concealed groove which guided his wheel and kept it from falling. His trick was accidentally exposed by a clown, who got his foot caught in the groove, and the disgraced looper fell into obloquy and oblivion. The public soon tires of the strongest sensations. The stationary loop gave place to the rotating circle called "the devil's wheel," in which the cyclist spins like a squirrel. Taking his place inside the wheel, which is about fifteen feet in diameter, he pedals in a direction opposite to that of the wheel, and thus remains at the bottom until the wheel has acquired considerable velocity. Then he stops pedaling, applies his brake, and is carried backward and upward nearly to the top, whence he rushes down, and flies around and around the revolving wheel with startling speed.

At a performance in Vienna, a cyclist, stricken with apoplexy, fell from the wheel and soon expired. But the danger of cerebral congestion is not the only one. The critical phase of the act is the last, when both the bicycle and the large wheel are being brought to rest by brakes. The bicycle lurches, and the slightest error in steering may send it through the open side of the wheel and precipitate the rider to the stage.

In Germany a genius called "Eclair" invented an infernal wheel of another sort. It was about twenty-five feet in diameter, and a smaller wheel rolled around inside of it, obtaining its impetus from a plunge down an inclined plane, which made a descent of fifty feet. To this small wheel "Eclair" was lashed in "spread eagle" fashion. He accustomed himself to this novel mode of locomotion by having himself strapped to a similar wheel, which was turned rapidly about a fixed axis by means of a crank.

More startling and perilous than any of these devices is the "circle of death." This is a large, flat, truncated cone, like the rim of a pudding dish, supported by ropes in a position slightly inclined to the horizontal,

so that only one side of the lower and smaller edge rests on the stage. Bicyclists—one or more—enter the central space, and run up and around the steep side with their machines and bodies nearly horizontal. Then, to add to the apparent and real danger, the whole apparatus is raised aloft. The effect is thrilling, for the riders appear to be in constant danger of falling. In Berlin, as three cyclists were gyrating in a single circle of death, one fell and carried a second down with him. They had scarcely reached the stage when the third performer fell also.

"The globe of death," an interesting and comparatively safe act recently exhibited in a New York theater, combines some of the features of looping the loop and the devil's wheel. Two bicyclists, a man and a woman, enter a stationary lattice-work globe some twenty feet in diameter, and course around it at great speed in both vertical and horizontal circles.

All of the acts hitherto described are performed with complete circles or loops. The next development was the removal of the topmost part of the vertical loop, leaving an air space through which the bicyclist flies head downward. This feat is called "looping the gap."

Mlle. Dutrieu, "the human arrow," produces a more graceful effect by traversing a gap in a track which would not, if complete, form a loop. The first section of the track is a plane fifty feet long, inclined 30 deg. to the horizontal and terminating in a short upward curve. The second section begins with a saddle-back curve, and ends in a plane inclined upward for the purpose of bringing the bicycle to rest. The two sections are separated by a gap of fifty feet, through which the cyclist flies like an arrow. It is worthy of note that women formed a large majority of the spectators of the human arrow's first public flight.

A feat, performed by the cyclist Marok, might be called looping without a loop. The track resembles the first section used by the human arrow, but the upward curve is longer and forms an arc of a circle. At the foot of the incline and the commencement of the curve the bicycle is caught by a wire suspended from the center of this circle. The machine, therefore, after traversing the curved path, describes the remainder of the circle in the air. Meanwhile the curved path is replaced by a level one terminating in an ascent, which receives and stops the cyclist when he returns to earth and casts off the wire.

In another ingenious and terrifying variation of the human arrow, the bicycle is replaced by a four-wheeled car, which is stopped abruptly by a buffer at the end of the upward curve, while the rider is hurled through space to a trapeze some distance away and fifty feet higher. Failure to catch the trapeze means certain death.

Another startling application of the same principle is made in an open-air performance which has been given many times in America, England, and Germany. The inclined track is erected on the shore of a lake or river, and is two hundred feet long. The starting platform is a hundred feet, the top of the upward curve about forty feet above the ground. When the bicyclist rides off the end of the curve into space, he lets go his machine and dives into the water. This frightful plunge terrifies the spectators, but the real danger is that of being struck and killed by the bicycle, a fate which befell James Fleet in Chicago.

An acrobat named Thompson makes a still more perilous plunge with the aid of simpler apparatus, leaping from the top of a very long vertical ladder into a tank some distance away, which measures only forty feet in length by eight feet in width. A slight error in making the leap would bring him to the ground instead of the tank.

The automobile, the queen of sport, shares with the bicycle the glory of these dangerous exhibitions. One of the latest developments is the monstrosity called the autobolide, which is making fame and fortune for Mlle. de Tiers. From an elevation of forty feet the first section of the track slopes downward at an inclination of 45 deg., and at its lower end curves downward and inward to form a semicircle. Down this track and around the outside of the curve rushes an automobile weighing nine hundred pounds, which is held to the track by rollers engaging with fixed rails. Running off the end of the curved track at a speed of thirty-five miles an hour, the vehicle flies through the air, inverted, to a hollow curve which rights it and sends it spinning down a long incline with still greater velocity. The whole journey occupies just four sec-

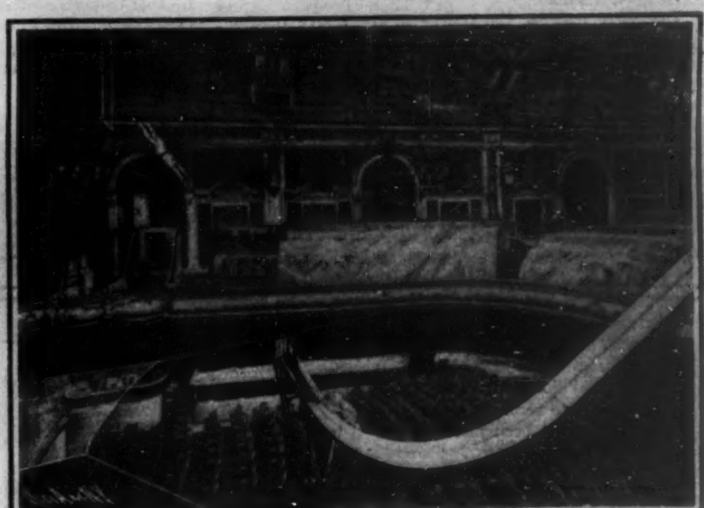
The Human Cannon Ball.

Diving into a Small Tank.

Eclair's Practice Wheel.

Eclair Lashed to a Wheel and Looping the Loop.

The Autobolide. The Automobile Turns a Somersault Before It Reaches the Ground.



A Variation of the "Human Arrow" Act, in which the Vehicle is Stopped Abruptly and the Rider is Thrown into the Air and Caught on a Trapeze.

A HUNDRED WAYS OF BREAKING YOUR NECK.

onds. As Mlle. de Tiers, inverted like her automobile, dashes around the sharp curve and is hurled into space, she experiences a painful sensation as if her head were being torn from her body, and with good reason, for the combined pull of gravity and centrifugal force exceeds two hundred pounds. The pain continues for many hours, and the danger is shown by the fact that in trials made with an empty automobile the vehicle has fallen three times. Yet this young woman has never felt the slightest fear, and she claims that at her first invitation performance she was less excited than the reporters who were present. This is the more remarkable because she is neither a seasoned acrobat nor a sportswoman, and has never even ridden a bicycle. Her act did not admit of practice. The first attempt was a sort of toss-up against fate. The woman won and has won ever since.

Another young woman has been less fortunate, for a terrible accident has abruptly terminated the exhibition of the aptly-named "whirlwind of death," in which she appeared recently at a Paris music hall. In this act the automobile, after running down an inclined plane and up a short curve, was projected into space in a nearly level position, like the bicycle of the human arrow. But when the vehicle had reached the highest point of its trajectory, it was caused, by an ingenious combination of springs and levers, to turn a complete somersault, after which it continued its flight to the receiving platform, forty feet distant from the point where it had left the first section of the course. The act was particularly thrilling because the vehicle, at the moment of the somersault, appeared to stop in its onward flight and, consequently, to be in imminent danger of falling to the floor, twenty feet below. This illusion was due to the very low position of the center of gravity, which caused the inverted body of the woman to move backward, at that instant, faster than the center was moving forward.

What is the incentive which impels these men and women to risk their lives nightly before crowds of spectators? Is it ambition, vanity, love of applause, or simply the hope of making a fortune? The American "looping the loop" was conceived in an essentially practical spirit, and "Diavolo," who received $600 a night, has become a rich man. Mlle. Dutrieu, "the human arrow," earns $80,000 a year, "Mephisto" received $140, Mlle. de Tiers $200 a night in Paris, and larger sums abroad. Imitators, of course, receive less than originators. The current pay for looping the loop is from $20 to $40 a night, which is not high, especially if the performer owns the apparatus, which costs at least $500.

It seems, therefore, that the hope of gain is not the only incentive, but that the performer, like the public, is attracted by the very danger of the act—a curious illustration of the fascination exerted by emotions which, in themselves, are disagreeable.

AIR PUMPS FOR EXPERIMENTAL PURPOSES.

BY W. P. WHITE.

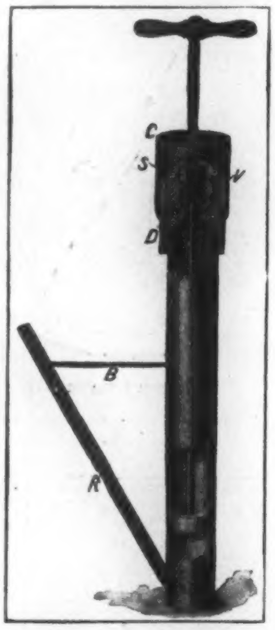
The four most important requirements for an air pump, arranged roughly in the order of their importance, are: (1) Absence of leakage; (2) absence of clearance; (3) absence of the vapor of water or other substance; (4) valves that will work with very small air pressure—so-called automatic valves. The effect of clearance or of vapor is about the same; with either we have a gas which either condenses or is compressed into the clearance space as the piston nears the end of the cylinder, to evaporate or expand again on the return stroke, thus keeping a considerable pressure always in the cylinder, and preventing the attainment of a good vacuum.

Curiously enough, the fourth of the above requirements has come to have an exaggerated importance attached to it. There have been on the market pumps which leaked badly, in which the question of clearance was neglected and that of vapor apparently never thought of, which nevertheless were the subject of great claims on account of some more or less complicated and expensive variety of automatic valve, whose advantages were usually far outweighed by the other defects of the pump. The most curious thing about the whole matter is that there has long been known a form of automatic valve (usually attributed to Prof. Tait) for many years made by one American manufacturer, which is simpler and better than most, at least, of the patented contrivances.

A really important improvement to most existing pumps would be the use of oil as a sealing material, which reduces both leakage and clearance exceedingly close to absolute zero.

Why it has not been more generally used is, to the present writer, a mystery. The idea is as old as the seventeenth century, and is familiar to-day in the mercury pump. The advantage can be seen when we reflect that the only defect of the oil pump worth mentioning, the effect of vapor from the oil, is a thing that is neglected in ordinary pumps. There is, therefore, nothing surprising in the fact that the exhaustion of the best oil pumps is measured in thousandths of a millimeter—hundreds of times as good as with ordinary mechanical pumps.

The immediate object of the present article is to point out the fact that even with the crudest construction, the oil pump is still far ahead. For instance, the pump shown in the figure was made as follows: An old bicycle pump was soldered up tight at the bottom. An inch up, a half-inch hole was drilled, and the slanting tube, *R*, soldered on, strengthened by the brace, *B*.



AN EXPERIMENTAL AIR PUMP.

This tube is to bring air from whatever is being exhausted. For the top of the cylinder a ring, *D*, cut from heavy brass tube, was soldered on, and into this screws the cylinder head, *H*, conical on the inside, so that all air bubbles may readily be swept up through the valve, *V*, which opens from the very top of the cone. The plug, *S*, makes a stuffing box for the piston rod. The piston is reversed, so as to force up instead of down. Last, but not least, a cup, *C*, to contain oil, is soldered to the ring, *D*, so that every possible opening by which air could enter is sealed by oil. Total cost, about $2. The action can be very simply described. Each up-stroke of the piston crowds out all the air above it, and when the piston returns below the side hole, air from the receiver is free to enter the empty space. In the following up-stroke the piston first, by passing the side hole, cuts off communication with the receiver, and then forces out the air above it. Tested with a McLoud gage, this pump gave an exhaustion of 0.2 millimeter. One might get more or less than this in another case, as it depends mainly on the quality of the oil. The oil in this case was commercial, heavy lubricating oil, not specially dried or treated in any way.

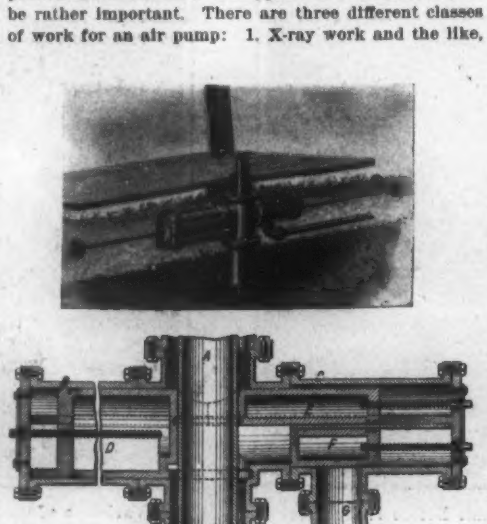
Although this pump, considering its vacuum alone, is only from five to ten times as good as the best mechanical pumps generally sold for experimental purposes, yet it really is far more useful. The excellence of these others depends upon good workmanship, and this means that they must be expensive, and that their efficiency is easily impaired by wear or by slight accidents. The oil pump is thus vastly more reliable, as well as cheaper and more durable. Moreover, the improvement in the vacuum happens to come in a way to be rather important. There are three different classes of work for an air pump: 1. X-ray work and the like, requiring a very high vacuum and all sorts of precautions outside the pump itself—of all of which there is no question here. 2. At the other extreme, the ordinary phenomena of atmospheric pressure, requiring a vacuum of several centimeters or better 3. Geissler tube and other similar electrical phenomena, ranging from 2 millimeters down, but showing special interest between 1 and 0.1 millimeter. The average pump just enters this region, but stops short of the best part of it—that is, when in fine condition; when in poor condition it is good only for the second class of phenomena, which can be shown, though not as well, by a common aspirator. Thus a moderately good oil pump opens one of the most beautiful and interesting classes of phenomena in nature.

An ordinary school pump can easily be made into an oil pump of the type here described. A hollow cone can be cast of type metal directly in the cylinder, and the rest is a matter of solder and sheet metal. Nearly every school has one or more old, worn-out pumps in its truck pile, which can easily be made better than new, since a large air leak will only leak a little oil, and a slight oil leak is a trifling inconvenience which does not affect the vacuum.

For moderate results alboline or liquid vaseline is a good oil to use, as it is not acted on by sulphuric acid, and can therefore be freed from water vapor at any time by shaking it up with the concentrated acid. For the best results no great expense is needed, but two problems are to be solved: 1. To find or make a vaporless oil. 2. To find a simple method of getting double exhaustion, so that the chamber which draws from the receiver does not come to atmospheric pressure at any time, but delivers into a good vacuum. There are at least three simple ways of doing this without using two cylinders, but this whole question is beyond the purpose of the present article.

VALVE FOR OIL WELLS.

Pictured in the accompanying engraving is an improved valve for oil wells which provides a tight joint at the stem of the drill and permits control of the oil during the drilling operation and thereafter. In the general view the drill stem may be seen passing through the floor of the derrick into the valve casing, which is bolted to the top of the oil tube. The details of the valve are clearly shown in the section view. The drill stem is indicated at *A*. Bolted to opposite sides of the main valve casing are two bonnets, *B* and *C*. The bonnet, *B*, is formed with rectangular base and sides and a dome-shaped top. Within it is the valve, *B*, which, in cross section, conforms exactly to the interior of the bonnet. The latter is provided with grooves adapted to receive tongues formed on the body of the valve. The inner extremity of the valve has a semi-cylindrical face, which fits closely around the drill stem, *A*. A perfectly tight joint is insured by the provision of hydraulic packing. The body of the valve is also made perfectly tight with packing strips set both transversely and longitudinally. The bonnet, *C*, which is of cylindrical form, is divided by a central partition into two chambers, one of which contains the valve, *E*, and the other the valve, *F*. The valve, *E*, like valve, *D*, is formed at its inner extremity with a curved face, adapted to fit snugly against the drill stem, *A*. The valves are operated by threaded valve stems, as illustrated. Under normal conditions, when the drilling operation is in progress, the stem, *A*, passes down through the body of the valve casing. The valves, *D* and *E*, are advanced so that their forward faces abut against the sides of the drilling stem, and form a tight joint thereabout, so as to prevent the upward flow of gas, oil, or sand. The overflow is controlled by means of the gate valve, *F*, which may open communication, if desired, with the overflow pipe, *G*. When the drill stem, *A*, is removed, the main valve, *D*, may be advanced so as to close the opening from the oil tube into the valve casing. The entire bonnet, *C*, may now be removed, if desired, and the pipe line connected directly in the position which the bonnet occupied. If the well is to be permanently closed both bonnets may be removed and a plug screwed down, so as to cut off communication between the oil pipe and the valve casing. The valve stems are operated by hand wheels which project beyond the end of the derrick floor, enabling them to be conveniently reached. Mr. Horace D. Bernard, 30 Chartres Street, Houston, Texas, is the inventor of this improved valve.



VALVE FOR OIL WELLS.

As the result of experiments extending over several months, it has been decided to abandon hard wood for street paving purposes in London. Hard wood not only severely damages the concrete foundation, but wears unevenly. The edges of each block wear away before the center, and the result is a corduroy-like ridge, which makes a very rough surface for driving over. Soft wood, on the other hand, wears evenly; the external pressure tends to spread the wood at the edges, thereby filling up the interstices between the blocks, and giving a perfectly even, homogeneous surface. The life of a soft-wood pavement is about ten years, and it has the additional advantage of wearing right down.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRICAL ROSETTE.—J. A. MEBANE, South Boston, Va. The present invention is a further improvement in the same line as that for which Mr. Mebane filed a former application for a patent. He has provided improved means for detachably connecting the base and cap of the rosette proper, also for insulating and protecting the fuse-wires and for attachment of conducting-wires. The improvement enables him to employ a fuse-wire of due length and to thoroughly protect and insulate the same from adjacent electrical connections.

SIGNAL SYSTEM.—W. B. BRUCE, Gallatin, Tenn. Many serious collisions have occurred on railroads because no means are provided for signaling trains between telegraph-stations. The main object of this invention is to provide such a signal system—one that will be absolutely certain to operate and one which will be simple and practical in every respect, and inexpensive to manufacture and maintain.

Of Interest to Farmers.

MILKING-MACHINE.—O. B. BRYANT, Ravenna, Neb. The object of this inventor is to provide novel details of construction for a machine that adapt it for convenient application to the teats of a cow, effect a painless milking operation that simulates hand-milking, and afford support for the machine on the animal while in use.

GATE.—G. W. FOX and D. E. SARVER, Laramie, Wyo. This is an improvement in gates, especially farm and ranch gates. One purpose is to provide a simple, economic, and effective gate, capable of being expeditiously and conveniently operated by a person either riding or walking—which gate is practically a self-opening and gravity-closing gate. Another is to provide an automatically-acting latch for the gate and to construct suitable guides, and friction-rollers on the guides, facilitating the action of the said gate.

HARROW-TOOTH.—J. W. SMITH, Troupe, Texas. Among the advantages of this improvement may be mentioned a more thorough cultivation and pulverization of the soil. A closer cultivation of crops may be also obtained. When used in a cultivator, a much more thorough eradication of weeds is secured than by the use of the ordinary cultivator-point, since the weeds are cut off beneath the surface of the ground and are turned under the dirt instead of being merely scratched, as with the ordinary construction.

Of General Interest.

BLADE-CLAMP FOR SAW-FRAMES.—J. GRIEVE, Dodge City, Kan. The object of the invention is to furnish an inexpensive clamping attachment for each of the ordinary blade-clamps on a saw-frame which affords convenient means for reliably securing the ends of the saw-blade in clamped condition thereon and that may be quickly and readily adjusted for clamping or releasing the saw-blade without requiring the use of pliers or any other implement to effect such an adjustment of the improved attachment.

HANGER FOR CABLE-HEADS.—F. M. WINN, Des Moines, Iowa. The hanger is particularly adapted for use in connection with the heads or portions of aerial conducting-cables which are made into distributing-boxes and the like. In use the bars may be secured at each side of the pole at a distance below the cable-head and the vertical portion thereof introduced between the curved ends. The stay is then brought into coaction with the pole and fastened to it and the bolt finally tightened to draw the ends of the bars into coaction with the cable and thus support it.

STEREOTYPE-MATRIX. — F. SCHREINER, Plainfield, N. J. This invention includes the process of making the matrices, as well as the parts of the matrix. The object is to simplify the production of matrices and to provide a process which may be carried out quickly by means of dried sheets which can be kept in stock ready for use at a moment's notice. It dispenses with the necessity of mixing paste as used in the ordinary matrix processes and provides a matrix which may be quickly dried and made ready for instant use.

DRILL-SOCKET.—G. A. SAGER, Albany, N. Y. The purpose of the improvement is to provide a socket in which a drill may be expeditiously and conveniently clamped and securely held whether the tang of the drill be intact or broken and to provide means whereby any size of drill may be positively held in the socket without danger of displacement even under the most severe strain.

CUTTING IMPLEMENT.—H. F. NEHR, New York, N. Y. This device cuts what is known in religious services as the "host." The cutting element is in the form of a ring, and can be produced at a minimum cost to enable it being entirely dispensed with when dulled and substituted by others. It is simple, durable, and can be quickly and conveniently introduced and held in position for use and when not needed can be placed in a holder with the cutting edge innermost, thereby protecting the edge and maintaining it in a clean condition.

STOVEPIPE-PROTECTOR.—S. B. GRAHAM, Corsicana, Texas. This improvement refers to stovepipe connections, and its object is to prevent the descent of products of condensation on the outside of a stovepipe. It is especially applicable where the stovepipe is vertical and is more necessary under these circumstances. It also operates beneficially to prevent rain-water from passing down the pipe.

TROUSERS-STRETCHER.—W. J. WARDWELL, Redondo, Cal. In this patent the invention has reference to trousers-stretchers; and its object is the provision of a simple device which may be easily applied to a pair of trousers in order to crease them at the lower extremities and enable them to be suspended as from a hook.

MUSICAL-INSTRUMENT BEATER.—J. P. STANTON, San Francisco, Cal. The invention relates to improvements in devices for beating bass drums and cymbals, the object being to provide a beater so constructed that it may be operated with great rapidity and lightness of action, that may be easily cleaned of dust that may gather thereon, and so arranged as to be compactly folded for transportation or storage.

BEARING FOR HANDLE-CAPS.—L. B. PRAHAR, New York, N. Y. The inventor provides a construction of bearing for handle-caps for bags and like articles, which construction is an improvement upon that shown in his former application for a similar device, the improvement being such as to simplify the bearing, providing a construction in one piece including a base, one or more posts, and attaching-lugs which extend down from the lugs.

BUCKET-DUMPING DEVICE.—J. C. KIRSCH and J. J. HARTMAN, Granite, Colo. This invention refers to a device for dumping a mining-bucket which has been elevated through a mine-shaft. The object of the improvement is to produce a device of this class which will operate easily and simply to effect dumping of the bucket, the operation being effected without necessitating the seizing of the bucket.

PROCESS OF MAKING MALTED COCOA OR CHOCOLATE.—W. B. KERR, Medford, Mass. Among the several objects of this improvement are the following: first, to render the cocoa or chocolate more easily digestible; second, to render the same more palatable, and, third, to make a combinational article of food suitable for many culinary purposes for which neither of the ingredients could be used separately.

SHOE AND PANTS DUSTER.—M. M. HITT, Luray, Va. This apparatus is adapted for removing dust and dirt from boots and shoes and the lower portions of pants-legs without the use of a hand-brush or other manually-operated device. The inventor arranges the brushes horizontally and opposite each other and supports them upon a suitable frame, their free ends being in contact, or nearly so, and thus adapted for contact with shoes and the lower portions of pants-legs when a person walks or otherwise passes his feet between the brushes.

POWDER-CARTRIDGE FILLER.—W. H. HAYES, Philadelphia, Pa. In this case the invention pertains to powder handling; and the object is to facilitate the removal of powder or similar explosive from canisters. It is expected to be especially valuable in connection with the filling of cartridges to be used for blasting. The primary object has been to prevent dangerous explosions.

UNDERWAIST.—E. H. HORWOOD, Hoboken, N. J. The purpose of the invention is to provide a construction wherein the armhole-section is double in its entirety and likewise a portion of the sides, thus rendering the waist much more durable, particularly at points subjected to most wear and strain, and, further, to provide means whereby such construction may be carried out in the initial operation in manufacturing garments, enabling the garment to be made with the same facility and no greater expenditure of time than in the ordinary single-ply garment, thus enabling it to be marketable, as the cost of manufacture is practically no more than that of the ordinary garment.

PHOTOGRAPHIC SOLUTION-BOX.—G. C. GENNERT, New York, N. Y. This device is for use in developing, fixing and washing photographic plates, comprising a receptacle and a tray having free movement in the receptacle, which tray holds plates in a standing position. The tray is supplied with handles so applied that they may be used for reciprocating the tray in the receptacle and for supporting and holding the tray partially out of the receptacle and entirely out of the fluid employed, enabling ready access to the plates.

DRUM-BEATER.—A. D. CONVERSE, Winchendon, Mass. The purpose in this instance is to provide simple mechanism for controlling the operation of drumsticks relative to the head of a drum or other surface to be beaten upon, which mechanism can be conveniently operated to produce taps of all descriptions given to a drum and which are usually produced by a drummer holding the sticks in the hand.

PHOTOSTEREOSCOPIC APPARATUS. — J. S. A. TOURNIER, Bourges, Cher, France. In appliances ordinarily used two identical objectives are parallelly arranged. They give either upon a single plate of sufficient length or upon two separate parallel plates two images individually inverted, and in each the right-hand portions of the object are seen upon the left-hand side and inversely left-hand portions on the right; besides, centers of the two images are always at the same distance apart as the centers of the two objectives. The result is, whenever obtaining a stereoscopic base larger than the distance apart of the eyes with small negatives the apparatus presents a large volume on account of space lost in its center. Capt. Tournier reduces the volume by utilising the whole space between the two objectives.

Household Utilities.

ATTACHABLE SEAT FOR WATER-CLOSETS.—H. PARKER, Asheville, N. C. A small portable seat-board is provided by this inventor having an opening of reduced diameter which may be instantly placed in position upon the seat proper, be firmly held in place automatically, avoid the least injury to the closet, and be readily removable when not in service. It can be carried in a case when traveling and when applied renders any closet having an ordinary seat-board available for the safe and convenient accommodation of small children.

DOOR-FASTENER.—G. W. NILES, Vanwert, Ohio. The invention is an improvement in that class of door-securers which are adapted for use independently of the ordinary latch or bolt forming an attachment of a door, the same having a member provided with a claw that engages the door-jamb and another member which is adjustable on the first-named one and adapted to abut the adjacent edge of the door and thus prevent the latter being opened from without.

WINDOW-SCREEN. — W. C. HILDEBRAND, Glenrock, Pa. By this invention an improvement is made in window-screens, especially in adjustable window-screens which can be extended and contracted to fit windows of different sizes as well as to facilitate their insertion and removal from windows. The object is to provide certain improvements in the devices for connecting the sliding sections of the screen.

Machines and Mechanical Devices.

MACHINE FOR TREATING CREAM.—O. H. NEBEL and J. H. PETERSON, Worthington, Minn. The invention has reference to improvements in machines for cooling or heating and tempering cream, the object being to provide a machine of this character that will be simple in construction, easily operated, and having no parts liable to get out of order. Means are provided for observing the condition of the cream in the machine.

MACHINE FOR FORMING AND ASSEMBLING CAN-SECTIONS.—L. C. SHARP, Omaha, Neb. This machine is designed for use in connection with the two-piece or one-seam can forming the subject-matter of Mr. Sharp's copending application formerly filed. The invention relates to an apparatus for forming and assembling drawn can-sections, and it comprises automatic mechanism for fully performing this work with the exception of the dies or other mechanism for giving the can-sections their primary shape.

HORSE-WHIPPING MECHANISM. — A. NEUDECKER, Clements, Minn. The object of the invention is the provision of a simple means in connection with the mill whereby should the animal slack up or travel at a gait below a desired speed a whip would be automatically released to strike and continue to strike the horse until the proper speed is gained, when the operation of the whip is automatically stopped, obviating the attention of a driver and thus resulting in an economical operation of a horse-power mill.

TYPE-MOLD FOR TYPE-CASTING MACHINES.—J. MAYER and C. ALBRECHT, Berlin, Germany. The invention relates to a type-mold to be used in type-casting machines of any known kind and by which it is rendered possible to cast a plurality of types, logotypes, or wordtypes at a time, whereby the production thereof is in proportion increased. The new type-mold can be used in place of the linotype-mold in linotype casting and composing machines, so that by this type-mold it is rendered possible to produce at pleasure various types.

CIGARETTE-MAKING MACHINE.—A. BENÔIT, J. GUÉNIFFET, J. NICAULT, and E. DANGER, 7 Rue Deparcieux, Paris, France. In this machine a core or cord of tobacco is formed and fed along continuously, while the paper tubes are carried by a drum moved intermittently along and around its axis. Each tube successively is moved backward and comes in a direction contrary to that of the core of tobacco over the end of the latter. Immediately it is filled with tobacco it is moved forward. During this latter movement the core is cut without being stopped by a blade moved at the same speed of translation as the core itself. When the cut is completed the drum is turned and presents a fresh paper tube in front of the cut end of the core, which tube is immediately moved back to be filled by this core. By a special arrangement the drum receives very rapid intermittent rotary motion.

Prime Movers and Their Accessories.

FLY-WHEEL AND CRANK-SHAFT STRUCTURE.—S. W. SHAW, Galesburg, Kan. The invention relates particularly to improvements in the construction of the crank-case, crank-shaft and fly-wheel of internal combustion-engines. The underlying object is to increase the compactness of the engine at the point of the crank-shaft and crank-case and at the same time to provide long bearing-surfaces, thus decreasing the friction and giving the moving parts greater and more support.

TURBINE.—C. RHOADES, Tilbury, Ontario, Canada. Steam or other motive fluid under pressure being supplied to the steam chamber will pervade the same, and the valves carried on stems being open it will pass through the nozzles, acting on the buckets at the periphery of the turbine-wheel to impart continuous rotary movement to the wheel, the speed proportionate to pressure of the fluid. Any or all nozzles may be cut out of action by operating the valves, which provide means for controlling the speed of rotation of the wheel. Means are provided so that during heavy loads steam jets will be forced through one or more buckets, exerting a part of the power on each succeeding bucket and avoiding choking the jets by the steam rebounding during slow speeds.

Railways and Their Accessories.

LANTERN.—A. C. DUDLEY, Kansas City, Mo. Mr. Dudley's invention relates particularly to improvements in signal-lanterns for railway use, the object being to provide an ordinary white-globe lantern with an auxiliary colored signal-globe so arranged as to be readily adjusted around a lamp-flame when required for signal purposes or raised above the flame, so that the white light will show, thus practically forming two lanterns in one structure.

RAIL-SANDING DEVICE.—W. T. WATSON, Vancouver, British Columbia, Canada. Provision is made in this invention for a simple and strong device for sanding rails and means for insuring a free flow of sand at all times. The device is intended to be attached to a railway-car and has a discharge-spout leading to the rails on which the car runs, the flow of sand being controlled by the motorman, conductor, or other person.

SIGN.—W. T. WATSON, Vancouver, British Columbia, Canada. The sign is intended especially for street-railway cars; but is useful for other purposes. The object of the invention is to provide a sign which will be uniformly visible in night and day and not subject to weather conditions. The light employed may be of any sort, but preferably an electric light, the rays of which are emitted at night, so as to make a luminous sign, and at day the lettering or other device produced on a plate will be plainly visible. Among the advantages, are means that prevent snow, sleet, and the like from obscuring the sign.

CAR-VENTILATOR.—T. H. GARLAND, Chicago, Ill. There is provision of means in this instance for securing efficient ventilation irrespective of the direction of motion of the car and at the same time to prevent the possibility of the entrance of snow, rain, cinders, etc., through the ventilator. Having no moving parts, it cannot easily become inoperative.

RAIL-CHAIR.—R. H. FELT, Traver, Cal. In this patent the object of the inventor is to provide a new and improved rail-chair arranged to prevent spreading of the rails, especially along sharp curves, to securely join adjacent rails without the use of fish-plates and the like, and to permit convenient removal of a worn-out rail to be replaced by a new one.

Pertaining to Recreation.

PLEASURE-WHEEL.—C. J. JONES, Imperial, Neb. The principal object of the invention, which refers to pleasure apparatus in the form of a rotating wheel, is to provide a rotating wheel or platform which will be capable of holding a considerable number of persons and which will, when rotated, automatically rise and fall upon a mast or other support.

PUZZLE.—E. C. HOWLAND, New Milford, Conn. The purpose in this case is to provide a puzzle in which rolling objects differently colored are by shaking the receptacle containing them brought simultaneously to certain positions over correspondingly-colored spots and to provide barriers so grouped and arranged as to offer the greatest possible obstacle to the accomplishment of the desired purpose.

AMUSEMENT DEVICE.—A. DEBATTISTA, New York, N. Y. This device is especially adapted for out of door use, wherein inclined, straight, or undulating tracks are employed, and cars are mounted to travel by gravity on said tracks, each car being provided with a platform and an object thereon, grotesque, illustrative or plain and adapted to serve as a seat for one or more individuals. Means are provided whereby through the motion of the car an up-and-down and a forward-and-rearward motion is imparted to the platform and object carried thereby.

SEESAW AND IRONING-BOARD.—G. W. FAIRBANKS, Blue Rapids, Kan. The aim in this invention is to produce a seesaw of simple construction having attachments which will readily adapt the same for use as an ironing-board. The invention concerns itself especially with the means for supporting the board, for adjusting the height thereof, and for securing the same against movement when used as an ironing-board.

Pertaining to Vehicles.

LAP-RING.—W. T. FIELD, Bond, Tenn. Mr. Field's invention is in the nature of a new lap-ring designed to couple up a singletree to any draft attachment or to connect two sections of chain or for any analogous purpose;

and it consists in a ring composed of two separate U-shaped sections, one part provided with longitudinal grooves and the other with inwardly-facing locking-lugs adapted to enter the grooves of the first named section and to be locked thereto by a half-turn.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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MUNN & CO.

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Inquiry No. 7347.—For manufacturers of wire supports to attach to the back of small wood picture frames.

Inquiry No. 7348.—For manufacturers of optical glass for telescope objectives.

Inquiry No. 7349.—For parties to do stamping No. 11 gauge soft rolled steel. The article is an extension toggle joint ¾ inch wide by 10 inches long.

Inquiry No. 7350.—Wanted, address of Stock Mold Co.

Inquiry No. 7351.—For manufacturers of gut strings used for stringing tennis racquets.

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Inquiry No. 7353.—For dealers in tobacco and fixtures for cigar factory.

Inquiry No. 7354.—For manufacturers of fittings for hermetically sealed water closet pans.

Inquiry No. 7355.—For manufacturers of machinery for printing names on advertising pencils; also address of manufacturers of the pencils.

Inquiry No. 7356.—For dealers in Stewart's embossing board.

Inquiry No. 7357.—For manufacturers of machinery for making carpet brooms.

Inquiry No. 7358.—For manufacturers of goods made from vulcanized or vulcanizable fiber.

Inquiry No. 7359.—For manufacturers of machinery for gumming paper.

Inquiry No. 7360.—For firms who manufacture detail parts of furniture, such as various parts of roll top desk and parts of sectional bookcase.

Inquiry No. 7361.—For manufacturers of stoves, cooking utensils, etc.

Inquiry No. 7362.—For manufacturers of puzzles.

Inquiry No. 7363.—For manufacturers of small, 2-wheeled, rubber-tired delivery wagon.

Inquiry No. 7364.—For manufacturers of vacuum hand pumps.

Inquiry No. 7365.—For manufacturers of steel chimneys.

Inquiry No. 7366.—For manufacturers of diving suits.

Inquiry No. 7367.—For manufacturers of machinery for making wood alcohol.

Inquiry No. 7368.—For parties who make a business of laying out plots, that is for building, viz.: houses, stables, etc.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9806) R. L. I. says: Please answer the following question through your Notes and Queries. This is probably an old question in one form or another, but it is new to me. A watch spring is coiled up tightly. It will then possess a certain amount of potential energy which will become kinetic when the spring uncoils. According to the doctrine of the conservation of energy, this energy which is stored up in the spring cannot be destroyed but will either be given back in the form of mechanical energy or transformed into some other form of energy. Suppose now that this coiled-up spring is slipped into a test tube of such a size that it will not allow the spring to uncoil, and the spring is dissolved in some acid. What becomes of the energy that was stored up in it? I suppose that it is transformed into heat. Would the heat produced by the reaction be greater when the metal is in this strained condition than when it is in a normal condition? A. We are frank to say that we do not know what becomes of the potential energy of a coiled spring should the spring be dissolved in acid and never get a chance to uncoil itself at all. This is an old conundrum, as difficult to answer as that other comrade of its own—"What becomes of the pins?" An answer to either would be about equally useful to the human race. We have many times answered this question, and always in the same way. The question has no practical value, and does not in any way interfere with the great law of the equality of cause and effect, which is in reality what is meant by the conservation of energy.

(9807) W. F. F. asks: I have been using a mercurial contact on a relay operating electric clock circuit, the mercury being held in a small cup forming one electrode and the other a plunger made of copper wire. After using for some few weeks the wire became entirely honey-combed and there was a carbon deposit on top of the mercury and on the sides of the cup. Can you advise what should be used as a plunger in the mercury? A. The copper wire used for the electrical contact becomes weak and fragile because of its amalgamation with mercury. This takes place slowly in the case of copper, but before long the copper is destroyed. A heavy platinum wire should be used, since platinum is not affected by mercury. We cannot account for a carbon deposit on the mercury. A deposit of oxide of copper in the form of a black powder is to be expected from the action of the oxygen of the air upon the heated end of the copper wire when the circuit is broken. If the black powder is carbon, it may be set on fire in a flame; if it is copper oxide, it will dissolve in nitric acid, giving the blue solution of copper nitrate.

(9808) G. B. asks: In projecting a lantern slide upon a screen with a single double-convex lens, the lines of the picture, when viewed close to the screen, within a foot or two; give the colors of the rainbow. If, however, the observer goes back ten or twenty feet more from the screen, all this color effect immediately disappears. Will you please explain why the color effect is not equally visible at this distance? I understand, of course, if a chromatic lens is used, there will be no such color effect. What I do not understand is why, when you can see it so plainly at a foot away you cannot see it equally plainly at ten feet, although all the other parts of the picture are equally visible at either distance. A. The colors which appear in a lantern slide shown by a single convex lens are not seen at a distance because the eye cannot see lines of the width of these lines of color at so great a distance. The fact is that a line one-tenth inch wide will be just visible at a distance of a little less than thirty feet. From this the distances at which other widths can be seen may easily be determined. Beyond the distance of visibility the separate colors cannot be seen, but the picture as a whole will be seen equally well at all distances. At the greater distances the eye accepts the larger features and does not seek finer details. For that reason a picture on a screen looks better viewed at a distance from the screen.

(9809) S. H. asks: Please explain to me, through your Query Column, why a file used to file a steel cylinder, that is revolving in a lathe, becomes a permanent magnet. A. We do not see any special connection between the use of a file in filing a revolving cylinder and its magnetism. Probably all files become magnets very soon. Being of hard steel the earth will soon magnetize them. All fixed iron or steel on the earth is magnetic with the lower end a north pole. We have noticed that files frequently hold the iron filings stuck on their ends, which shows that they had become magnetized. It is a very common occurrence, and doubtless due to the inductive effect of the earth upon them.

(9810) E. L. says: Does the wheel on the outside rail revolve oftener than the wheel on the inside rail? If not, why not, recognizing that the outside rail is longer than inside rail? A. We would say that the wheels on a steam railroad car or locomotive are rigidly attached to the axle, and therefore have to revolve together at exactly the same rate of speed. The outside rail, however, on a curve, is longer than the inside rail. This makes a certain amount of slippage between the wheels and the rails unavoidable when going around curves. The wheels, however, are somewhat larger in diameter near the flange than they are a few inches away from the flange, and the tendency is for the flange to hug the outer rail of the curves. Therefore, the outer wheel as it is rounding the curve is rolling on a somewhat longer diameter than the inner wheel. This tends to decrease somewhat the amount of slippage there would otherwise be.

(9811) E. N. writes: I have noticed recently in your correspondence column articles on lunar rainbows. I do not know what caused the discussion, but will say I have seen rainbows at night twice. In the early part of the spring of 1904 my attention was called to one of these. The time was about 8:30 P. M. A light rain had been falling, and the full moon shone from the east at an angle of about forty degrees. The arch of the rainbow was almost perfect, and I do not believe I ever saw a brighter-colored one. I do not know how long it lasted. About a month later I saw another one of these occurrences. The time and conditions were about the same, but the bow was not nearly so bright as the first. A. Many of our correspondents have reported lunar rainbows since the matter was first mentioned in our paper. Some have, however, been mistaken in calling what they saw a rainbow. A rainbow is always on the opposite side of the horizon from the sun or moon at the time. If seen in the morning, the solar rainbow is in the west; and if seen in the evening, it is in the east. So, too, the lunar rainbow is always opposite the place of the moon. As you say the moon was in the east, you saw the bow in the west. An arch of color seen on the same side of the sky as the sun or moon is not a rainbow, but a halo, and it is formed not from drops of falling rain, but from crystals of ice suspended high in the atmosphere. The colors of halos are often as bright as those of rainbows.

(9812) H. A. S. asks: Will you kindly enlighten me through your columns on the following discussion: A claims that a body in motion in going around a curve, such as an automobile for instance, the outside wheels leave the track; for this reason railroad tracks are superelevated or banked. B claims that the inside wheels leave the track; for this reason in all automobile races the turns are from right to left and the steering wheel at the right side of the car, and the machinist sits on the left side, more to act as ballast than anything else. If the inside wheels leave the track first, please explain. A. A vehicle turning a corner too rapidly will overturn outward. This is because centrifugal force is developed, and acts from the center of motion or toward the outside of the track. This has been fully discussed in this column several times lately, and we refer you to Queries 9110, Vol. 89, No. 6; 9488, Vol. 91, No. 23; 9576, Vol. 92, No. 12. We send the three papers for ten cents each.

(9813) E. P. C. asks: 1. I have made a small induction coil, the secondary of which is in two sections; 1½ pounds of No. 34 wire to the section. These two sections differ considerably in power, owing I think to the one made first being partially broken down; e. g. where section No. 1 is working alone, excited by two large bichromate cells, it yields sparks 1½ inches long. Section No. 2 under the same conditions gives sparks nearly 3 inches in length. The sparks from either section, however, are white, large, and of uniform size throughout their length. Now, when both sections are in place and working as one coil, the appearance of the spark undergoes a marked change. It is then about 4 inches in length (same battery power), but the full, white appearance only extends for about one-third of the distance from one pole, the remainder being much smaller, and of a reddish color. What is the cause of this? A. The short sparks given by the separate section of your coil are what are called "fat" sparks. They have greater intensity. When the two sections are joined in series, the long spark given when the terminals are wide apart are those which are characteristic of sparks that are near the limit of the ability of the coil. These show the dark space at the negative pole, and are bright only at or near the positive pole. What we have said is descriptive of the sparks, and does not give a cause or reason for these marks or characteristics. These causes are not known. 2. I see in Norrie's work on induc-

tion coils (p. 130) mention of a "great Spottiswoode coil" which will pierce a plate of glass 6 inches in thickness. Could you give me any information in regard to this instrument, by whom made, some of the principal dimensions, etc.? A. The Spottiswoode coil was the largest made till recently. Its length was 4 feet; diameter, 20 inches; weight, over 1,600 pounds. Its secondary contained 280 miles of wire in four sections, of two sizes, the finer about 0.01 inch thick. Total number of turns in secondary, 341,850. It required 30 Grove cells to produce its greatest length of spark, 42¼ inches. In recent years coils giving sparks of 45 inches have been made, one of which is described and illustrated in the SCIENTIFIC AMERICAN for January 5, 1901. 3. Can you furnish a book called "The Construction of Large Induction Coils," by A. T. Hare? A. We can send you A. T. Hare's "Construction of Large Induction Coils" for $2.50.

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Nail, M. Hermelink 800,912
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Nitrating aromatic amins, Horsberg & Thom 800,913
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Nut removing device, axle, McDonald & McGillivray 801,037
Nut, toggle, F. D. Ogden 800,760
Oil receptacle, N. Platt 800,819
Ordnance, breech loading, S. N. McClean 800,757
Ores, reducing, H. Arden 801,129
Organ, viol, E. Ringer 801,106
Overalls, H. Edelman 801,138
Overshoe holder, J. Mardis 800,029
Packing, rod, E. J. Norton 801,153
Paint or oil can, J. B. Hall 800,903
Painting or coating machine, J. H. Neville 800,758
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Paper tube cutting machine, H. J. Hurd 800,649
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Pegging machine, J. F. Davey 800,724
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Pen guide, H. G. Becker 800,707
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Permutation lock, E. E. Higinbotham 800,648
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Phonographic recorder, P. Weber 800,890
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Pipe joints, forming, M. Kronauer 800,924
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Pistol, H. Bennett 800,709
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Plant protector, C. Landon 800,746
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Planter, cotton or seed, R. S. Bonner 800,620
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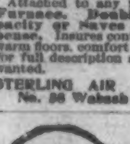

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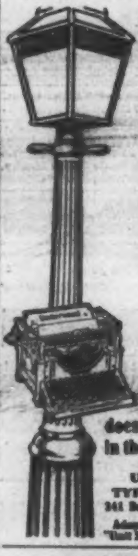

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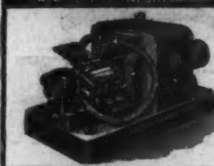

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